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VOLUME XXX.

Another year is passed and to-day we begin a new one; and while we return thanks for past favors and forbearance, we respectfully ask a continuance of the same for the future. The departing year will long be remembered as being characterized by one of the most extensive and the most groundless "scares" that has ever been known in the annals of gas property. It seems almost ridiculous at times, as we read in the daily press the glowing accounts of what the different inventors *are going* to do, and then turn to discover, if we can, what they really *have* done, in the matter of electric lighting. Another singular circumstance in connection with this, as well as with all other causeless scares, is that those least informed, and, consequently, least qualified to judge, are the most difficult to convince of the real truth in the matter; so that while intelligent engineers, managers, and others accustomed to weighing the value of novelties, have satisfied themselves that gas has nothing to fear from electricity, but rather something to gain; still, the stockholder whose eyes are dazzled and blinded by the electric light, or newspaper accounts of it, is on a different ground altogether, and from the very fact that he knows but little of the details of the business in which he is interested, is all the more ready to believe anything that has the least bit of "lightning" in it.

The only thing that convinces them is a Dividend! Give them a good guarantee of a regular dividend, for a term of years, and they can understand that. Looking at the matter from this point of view we can see nothing but encouragement to the stockholder for the future; and if every gas stockholder in the land will only subscribe for and read this JOURNAL regularly, we guarantee not the dividends exactly, but to give due notice when there is any probability of their being discontinued on account of electric or any other light. The stockholders, and especially the directors of gas companies, should not content themselves with "looking at the copy on file in the office"; but each should have and read his own.

From all the informatian that we can gather, the vast majority of companies stand better financially than they did one year ago. The volume of business may not be greater, in some cases it is less; but the *net profit* makes a better showing, resulting from greater skill and economy, in most cases, in the retort house.

A few years ago anyone that talked of getting five feet to the pound of coal would have been smiled at to say the least, yet to-day it is a fact shown on many daily reports, not as an average of every day, perhaps, but of sufficient frequency to establish the possibility of its becoming even a *low* average. Still further economy may be possible in the cost of gas; but, as a general rule, it will have to be derived from the distribution and not the manufacturing charges. We are satisfied that much may be done at that end of the line, when the proper time comes; but more of this at another time.

Before the end of the year now comme we expect to see some marked changes in the of heating benches; and experiments now going on, upon a practical working scale, seem to indicate that not only the cost of carbonizing may be reduced somewhat, but the character of the labor required of the stoker will be made much easier and more effective. There is talk also of large experiments *about* to be made in heating gas. How this may result time will show; but we venture to say that good illuminating gas, of 16 candle power, when properly burned in the best constructed gas stoves, if sold at a fair price, will answer most of the requirements for domestic use, both for lighting and heating, without the introduction of a double set of meters, pipes, and fixtures, with one of them filled with carbonic oxide.

There is a single word that we desire to add in wishing our patrons a "Happy New Year." It is business, and we state it in a business way This JOURNAL is conducted on a cash basis; we pay cash and are at all times ready to receive cash whenever it is due. Do not think for a moment that because our bills are small it does not make any difference to us *when* the remittance is made. It is the aggregate of these small bills that must meet the current expenses. We are aware that three dollars seems a small amount for which to draw a check; but if this is a decided objection, all that is necessary is to send the name of an additional subscriber, and a check for six dollars.

To our advertisers we would simply say that our circulation is daily increasing and that there is no other way of reaching the gas business so directly and so constantly as through our columns.

LECTURE UPON THE ELECTRIC LIGHT.

Delivered Oct. 17, 1878, Before the American Gas-Light Association,
By Prof. HENRY MORTON, Ph.D.,
Pres. Stevens Inst, Hoboken, N. J.

Gentlemen of the Gas-Light Association:—I purpose this evening to show you what the electric light now is in the various forms in which it has been developed up to the present time, and also to give some account of its history, and to point out, from a study of the latter, what are the reasonable prospects of its future development.

In the first place, evidently an electric light is some source of light developed by electricity, and as there are three distinct methods by which electricity may be caused to develop light, we have naturally three distinct sorts of electric light.

Naming these in the order of their intensity, they are—

The Electric Arc,
Ignited Conductors,
Incandescent Gases.

These I will show you and explain in their order.

THE ELECTRIC ARC.

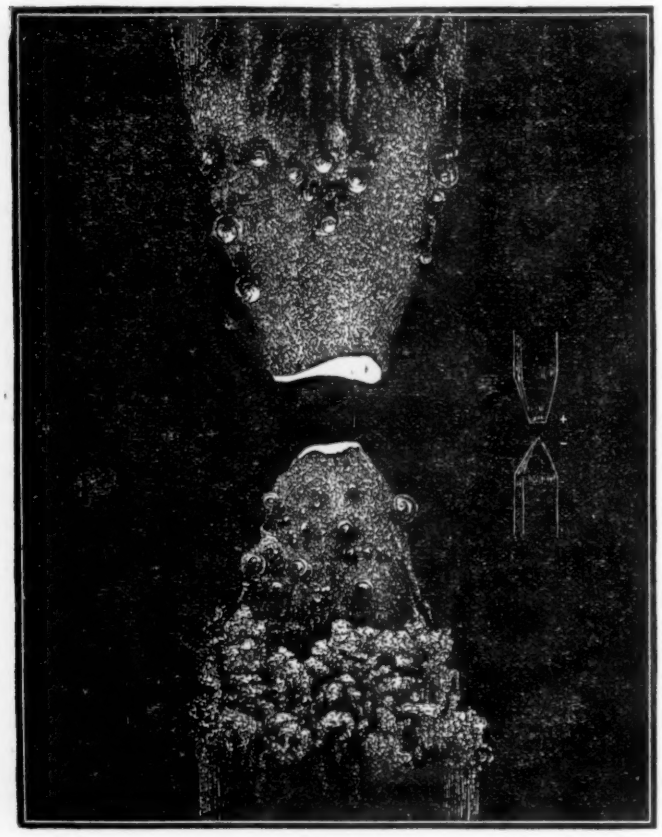

Fig. 1.

The electric arc may be said to have made its first appearance on this planet in the laboratory of the Royal Institution, in London, when Sir Humphrey Davy, in 1808, made his famous experiments with the galvanic battery of two thousand pairs of plates, with which he decomposed soda, potash, etc., and discovered their metallic bases.

The experiments of Davy were repeated and extended by various continental investigators, and in this country by the elder Siliman, of Yale, who first noticed and described many of the characteristic phenomena of this electric discharge, or "Voltaic arc," as it is called.

Its image was first projected on a screen by Foucault, and "electric lamps" or regulators were, at an early period, devised by him, by Deleuil, by Duboscq, and by many others; and efforts to improve these in the way of rendering them more efficient in producing a reliable and steady light, have continued down to the present day, and are by no means at an end now.

In order to understand these, it will be necessary to consider a little what this "electric light," "electric arc," or "electric discharge," is, or consists in.

When two pieces of dense charcoal, retort carbon, or the like, are connected each with one pole of a galvanic battery, consisting of fifty or more pairs of plates powerfully excited, and, after being brought into close contact, are slightly separated, a stream of electric fluid, as we call it, rushes from the positive to the negative pole, carrying with it particles of the carbon, as well as filling the space between with vapor of the same. The particles thus torn off are exceedingly heated by this action, as also are both the poles between which they fly, so that all becomes intensely luminous. The intensely hot and luminous poles constitute the "electric light" of this form.

I now cause the image of the electric arc to be projected upon the screen, and you there see (Fig. 1) what I have described. If we place a piece of silver in a carbon cup, arranged as the positive pole, it is, as you see, instantly fused into a luminous white-hot globule, from which springs a tongue of emerald green flame, and also a cloud of silver smoke, or vaporized silver, forming a swaying curtain or veil around the brightly luminous globule and negative pole of carbon.

Beautiful and intense as is this electric arc, it is evident that, in order to become useful, it must be rendered constant and uniform in its action.

Now, to render this electric arc in any degree constant and reliable, a variety of conditions must be provided for.

Thus, in the first place, as I have already noticed, a part of the carbon is actually vaporized. This causes a wearing away of the poles. Again, the carrying of particles of carbon from one pole to another changes the form of each. If the action goes on in the air, there will also be an actual combustion of the carbon poles. To counteract these sources of irregularity regulators of various sorts, operated by clock-work or by gravity, and controlled by the current and the consumption of the carbons, have been devised by Duboscq, by Foucault, by Gaiffe, by Serrin, by Deleuil, and many others.

The difficulty with all these, is that, however well they may regulate everything else, they cannot regulate the minute accidental variations in the structure of the carbon poles during their consumption, by reason of which these sometimes become very thin near their extremities, which

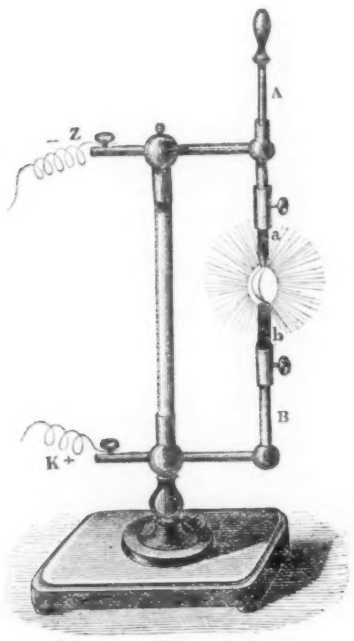

Fig. 2.

diminishes the amount of light produced, and at others change their shape so as to allow the main discharge to pass more to one side than another, so shifting the source of light from side to side of the poles, the side furthest from the discharge always emitting much less light, and being shaded by the pole itself from the greater light produced on the other side.

Thus, for example, with an electric arc springing, as shown in the cut Fig. 2, from the left side of the poles, a b, many times as much light will be emitted towards the left as will come towards the right, and as the arc flies around, this direction of maximum of emission will, of course, change with it.

So immense are the fluctuations produced in this way that, in the experiments which I have myself made, I found the same light, measured from a given direction, to change, within a few minutes, back and forth between 400 and 2,000 candles.

The use of reflectors and shades tends to equalize these irregularities, but they are present to a marked degree in all arrangements which have ever come under the notice of the present writer, notwithstanding the contrary assertions of all their respective inventors or promoters. Thus, only a few days after I had first noticed the electric lights used in the basement hall of the Equitable Building, and had remarked their exceptional irregularity, I saw in one of our mechanical journals a long article on the very

regulator there used, describing it as *the* successful solution of the problem of a perfectly steady electric light. Again, a few days since I was visited, within a few hours, by one of the prominent promoters of electric lights, who described to me the universal satisfaction expressed by every one with *his* regulators; and by one of our largest mill owners, who was anxious to introduce electric lights into his mills, but having examined *this same* light in a place where a number were in constant use, found that *that* regulator, at all events, was entirely too unsteady to answer.

All things, of course, have their degrees, and there are undoubtedly numberless places where the best regulators are quite steady enough to do all that is required. But certainly the problem of an electric light *steady* enough for *all* uses has not approached a solution in the direction of what are known as "electric light regulators."

Many years ago elaborate experiments were made to overcome this difficulty by employing a stream of mercury, falling in successive drops from one reservoir to another, as the source of the electric light. This was known as the Way light, and extensive experiments, with massive and costly apparatus, were carried on to test its efficiency. The volatilization and oxidation of the mercury, the want of constancy in the light, and other like causes, however, led to the abandonment of these experiments, after a large sum had been expended.

To dispense with the costly machinery of these mechanical regulators, M. Jablochkoff has recently carried out the ingenious plan of making a sort of electric candle, in which two parallel rods of carbon, separated by a narrow band of fusible porcelain, are supported vertically and made the poles of an electric circuit. The current, leaping between their ends, melts down the barrier of porcelain as the rods are consumed, and thus the "candle" burns down. This arrangement has, without doubt, the merit of simplicity, but it has found little favor in this country, because it has proved to be less reliable than the "mechanical lamps" or "regulators," and to involve a great waste of power, expended in overcoming the resistance of the interposed porcelain.

In this department of electric lighting, the case stands, I believe, at the present day thus:—Improvements in electro-motors (that is, machines for producing electricity, of which we shall speak further on) have given us relatively cheap electricity, obtainable with convenience wherever steam power is at hand; but the electric light regulators of to-day are not essentially different from, or much in advance of those of fifty years ago; and, while they will furnish a light reliable enough and steady enough for a vast number of uses, they are by no means fit for universal application, nor does the progress which they have made in the direction of improved steadiness hold out any strong encouragement to hope that much more can be done in this direction, unless some radically different method can be discovered.

The questions of economy, efficiency, and practical application of the "electric arc," as a source of illumination, as well as the proper basis of measurement by which to determine its actual performance, I will discuss further on after we have considered other departments of the subject which must be included in such consideration.

We will turn now, therefore, to the next form of electric light—that mainly produced by

INCANDESCENT CONDUCTORS.

In some of the early experiments of Sir Humphrey Davy, we find mention of the heating to luminosity of wires of various metals, as tests of the comparative power of different batteries; and, in 1858, so great an advance had been made in the practical utilization of this means of lighting, that M. Jobart, in a report to the Academy of Sciences in Paris, was able to speak as follows:

"I hasten to announce to the Academy the important discovery of the dividing of an electric current for lighting purposes. This current, from a single source, traverses as many wires as may be desired, and gives a series of light ranging from a night lamp to a lighthouse lamp.

"The luminous arc between the carbons produces, as is well known, a very intense, flickering, and costly light. M. de Changy, who is a chemist, mechanician, and physicist, is thoroughly conversant with the latest discoveries, and has just solved the problem of dividing the electric light.

"In his laboratory, where he has worked alone for the past six years, I saw a battery of twelve Bunsen elements producing a constant luminous arc between two carbons, in a regulator of his own invention—this regulator being the most simple and perfect I have ever seen. A dozen small miner's lamps were also in the circuit, and he could, at pleasure, light or extinguish either one or the other, or all together, without diminishing or increasing the intensity of the light through the extinction of the neighboring lamps. The lamps, which are enclosed in hermetically-sealed glass tubes, are intended for the lighting of mines in which there is fire damp, and for the street lamps, which would by this system be all lighted or put out at the same time, on the circuits being opened or closed. The light is as white and pure as Gillard's gas, with which it has one point in common, namely, its production by the incandescence of platinum. The gas pipes are replaced by simple wires, and no explosions, bad smells, or fires can take place.

"The trials that have been hitherto made, with the object of producing an electric light by means of heated platinum, have failed on account of the melting of the wires. This difficulty has been overcome by M. de Changy's dividing regulator. The cost of the light is estimated to be half that of gas. A lamp placed at the mast head of a ship would form a permanent signal for about six months without the necessity of changing the platinum. With several such lights, placed in tubes of colored glass, it would be easy to telegraph by night, as they could be extinguished and relighted rapidly from the deck.

"For lighthouse purposes considerable amplitude can be given to the light. I also saw a lamp so arranged, in a thick glass globe, that it could be immersed to considerable depths without being extinguished by any movement. This lamp has already been used in the taking of fish, which were attracted towards the light.

"The above slight description will suffice to show to what a variety of applications this discovery can be put. The communication which I have had the honor of laying before the Academy is founded upon no illusion; a lamp was, to my astonishment, lit in the hollow of my hand, and remained alight after I had put it in my pocket with my handkerchief over it."

In looking the matter up in the *Comptes Rendus*, or minutes of the French Academy, I find that the communication of M. Jobart was received at the meeting held March 1st, 1858, and was referred to M. Becquerel. At the meeting of April 5th, M. Becquerel reported that he did not find anything sufficiently definite to warrant the Academy to express an opinion as to the importance of this discovery. "All that was desirable at present was fuller information." At the meeting of April 19th M. Jobart responds to this request by stating that "he could not give more precise details without exposing the author to see another profit by his discovery."

Familiar as is the fact that history repeats itself, we cannot but be struck by the many points of resemblance between the above and what we read in the newspapers of to-day, concerning the wonderful doings of Menlo Park, and must hope that Mr. Edison's inventions will escape that permanent obscuration which seems to have finally shrouded M. de Changy's.

It would appear as if this brilliant and complete success described by Mr. Jobart as achieved by M. de Changy in Paris, in February, 1858, was very rapidly followed up in this country, for I learn from a letter in the Salem *Observer* of Nov. 2, 1868, that Mr. Moses G. Farmer, or some friend of his in Salem, lit their parlor for every evening during July of 1859 with electric lamps operated on a like principle.

It is true that nineteen years have not sufficed to render this admirable arrangement successful in practice, but what is that to the prophetic mind which, foreseeing what is to happen in the "near future," naturally overleaps distinctions between past and future, theory and practice.

For us, however, who only know the past and the present, it may be well to look a little closer at the means actually used, and the results obtained, in these and other experiments.

In the first place, let me show you what this light by incandescence actually is.

There is a coil of platinum wire, through which I pass the current from a battery. It grows first red, then yellow, then white, and now it gives out a beautiful soft and steady light; but we must be cautious; if I allow the current to become a little stronger, the wire fuses and drops asunder, and our experiment is at an end.

It is, as I understand, just here that Mr. Edison has made his much announced but carefully concealed invention. He has devised some simple and ingenious arrangement by which the solid conductor can be brough up to the highest point of incandescence, without risk of fusion.

True, this achievement was claimed for M. de Changy, and seems to be implied in Mr. Farmer's description; but somehow, as with the famous perpetual motion machine, "the little screw which makes it all go" does not appear to have been forthcoming in either case; and in this present year of 1878 we still look to the "future," "near" or remote, for the "practical success" so confidently announced nineteen or twenty years ago.

The first electric lamp operating by incandescence of which we have any actual record seems to be that invented by the American, Starr, a patent for which was taken out in England by his agent, King, in 1845, and which has thus come to be known as the King lamp. This lamp has been modified in details until it has reached the form shown in Fig. 3, known as the Konn lamp.

This apparatus consists of a glass vessel provided with a metal cap and packing box below, by means of which it can be closed air-tight.

A connector at K allows of the exhaustion of air from the interior, and the filling of the interior with any inactive gas.

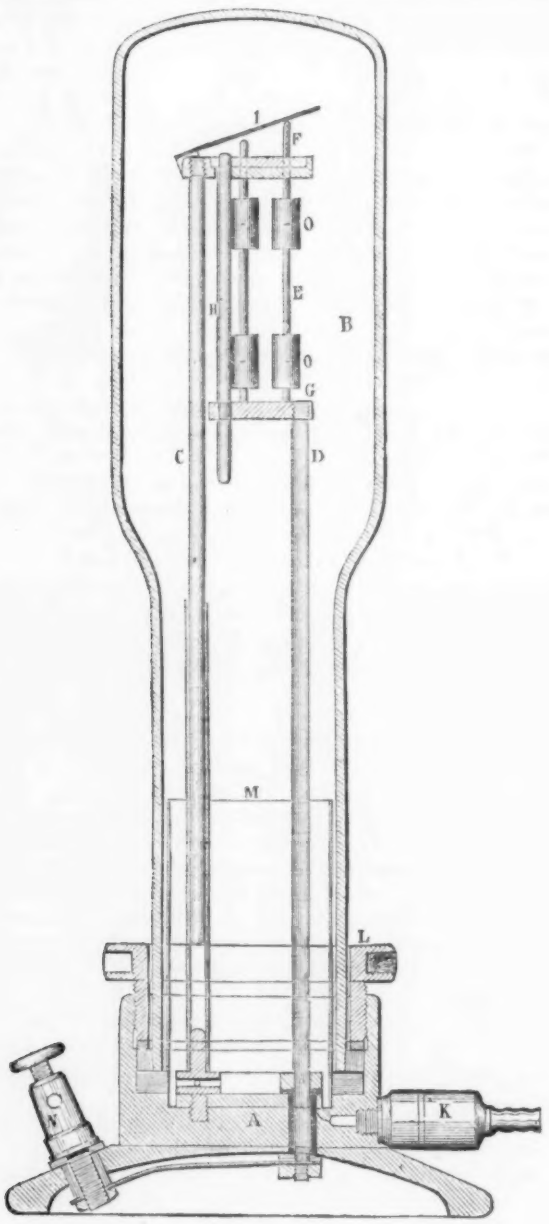

Fig. 3.

Two upright metallic conductors, connected respectively with the two poles of the electric circuit, pass up through this glass vessel and at their upper ends support, as shown, two or more rods of carbon or other conductors. The electric connection with these rods is made from C by means of the lever I, which communicates first with the longest rod, F, and when that is burned up, falls upon the next longest, and so on. The light is produced by the rod of carbon heated white hot by the current.

Various slight modifications of this lamp have been made and elaborately experimented with; but they all show the same essential characteristics. The first of these is that, as long as any oxygen remains in the vessel, the carbon rods consume rapidly, the first one generally lasting only twenty minutes. The second carbon will, however, last two hours if the light does not exceed forty burners; but even when all active gas has been removed, the carbon suffers a sort of vaporization.

The second characteristic of these incandescent lamps is that, with the same current, they develop much less light than is obtained from the electric arc. Thus, a battery of 48 elements, with a Serrin lamp, gave an electric arc equal to 100 burners; but with one of these lamps gave a light equal only to 80 burners, and when divided between three lamps, gave only the light of 10 burners each.

The third characteristic is the manner in which the light-producing power of the current diminishes as it is distributed between a number of lamps. Thus, the current from a given battery, acting on one lamp, produced a light between 4 and 5 burners; on two lamps, a light of 1½ burners each; on three lamps, one-third to two-thirds of a burner each. From another battery, the current on a single lamp gave a light of 11 to 12 burners; with two lamps, one-half burner each; and on three lamps, one-ninth of a burner each.

In another case a given battery with one lamp gave the light of 9 burners: with two lamps, 2½ burners; and with three lamps, one-third of a burner each. Another battery with one lamp gave a light of 65 burners; with two lamps, 7½ burners; with three lamps, 1½ burners; with four lamps, three-fourths of a burner; and with five lamps, one-half burner each.

In this connection it is curious to notice that the latest accounts from Mr. Edison show that he gets a light equal to about 48 candles, or three argand gas burners, per horse power with his new device, and with similar machines for producing the electric current and the electric arc, from 1,000 to 2,000 candles per horse power; thus showing remarkable agreement with these earlier experiments as to the loss of effect resulting from the subdivision of the light.

Another modification of this Starr or Koun lamp is found in that which has been recently exhibited in New York as the Sawyer-Mann lamp.

This differs from the former apparatus in no important feature except that the interior of the vessel is said to be filled with pure nitrogen at the ordinary pressure. The carbon rods are said not to waste away in these lamps. Without knowing anything positively on the subject, my opinion is that this is only because they have not been subjected to strong currents, but have only been heated to the extent of yielding the light of one or two burners. Under these circumstances, the carbons of the Koun lamp will last a long time, but on the other hand, the light so obtained is not economical, as we see above.

When exhibited in New York recently, we understand that five lamps only were operated by a magneto machine of Arnoux & Hochhausen, driven by a three-horse power steam engine, said to be developing only one and one-half horse power.

It is certain that none of these lamps have yet demonstrated anything like such practical success as can enable us to see that they can take the place of gas in ordinary illumination. They have, of course, many advantages in certain respects over the electric arc, but these are combined with compensating drawbacks on the part of economy; and it is only by turning our eyes to the as yet *unrevealed possibilities of the future* that we are able to see the electric light as *a successful substitute for gas and other methods of illumination.*

Another method of electric illumination by ignition is that suggested by Jablockkoff some time since, but which seems to have been abandoned practically on account of the costliness of the apparatus, not to mention other difficulties.

This consists in causing the main current to pass in a series of intercepted or reversed pulses through the primary circuits of numerous induction coils, and then to pass the induced sparks, obtained from the secondary coils of these instruments, across or around little rods of porcelain, which thus become heated to whiteness.

Fully to understand this it will, however, be necessary to explain the structure and operation of an "induction coil," and this comes naturally now in order in connection with the third method of obtaining light from electricity, namely,

ELECTRIC LIGHT FROM INCANDESCENT GAS.

In order to obtain electricity in such a state that it will pass through a gas and thus heat it to luminosity, we must, in practice, make use of an induction coil.

One of these instruments is shown in Fig. 4, as seen outside, and in section in Fig 5; its structure and mode of operation may be described as follows:

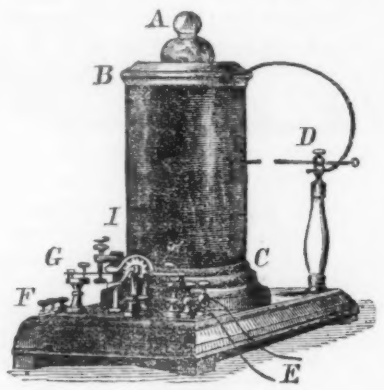

Fig. 4.

Beginning from the interior of the structure we have in the first place a core A B, formed of a bundle of soft iron wires. This is surrounded by a

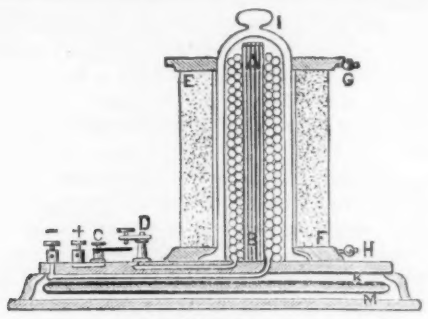

Fig. 5.

coil of thick copper wire so arranged that an intermittent current of electricity from a galvanic battery may be passed through it. This interruption is effected as follows: The current from the battery enters at the binding screw and passes by a brass strip to the column C and thence to the brass spring, which rests against the screw D, thence by the column D into the coil indicated in section around A B, and out again to the battery by the binding screw. When the current is to be interrupted, a hammer, omitted in the figure, falls upon the spring between C and D, so striking it away from the screw D. When the current passes, it powerfully magnetizes the core, and when it ceases, the core rapidly (we may say instantly) loses its magnetic properties.

Outside of this coil thus carrying the battery current, and which is known as the "primary coil," or "primary circuit," is another coil, E F, usually of very fine copper wire of great length, varying from hundreds of feet to hundreds of miles in different instruments. This is known as the "secondary coil," or "secondary circuit," and in *it* is produced, by magneto-dynamic induction, a momentary current at the instant when the iron wires of the core become magnetic, and another momentary current in an opposite direction at the moment when the core loses its magnetism. This gaining and losing of magnetism is, of course, the result of the passing and stopping of the primary current, and thus, in this sense, the secondary or induced current is caused by the primary one. If in place of simply interrupting the primary current, as above, rapidly alternating currents, in opposite directions, are sent through the primary coil, the practical result will be the same. These momentary induced or secondary currents have as we say, high intensity, being able to leap over distances and pass through resisting materials.

Thus the coil shown in Fig. 6, constructed some years ago for the present writer, and which contains, in its outer or secondary coil, 50 miles of wire, will throw a spark 21 inches through air, or through a block of solid glass

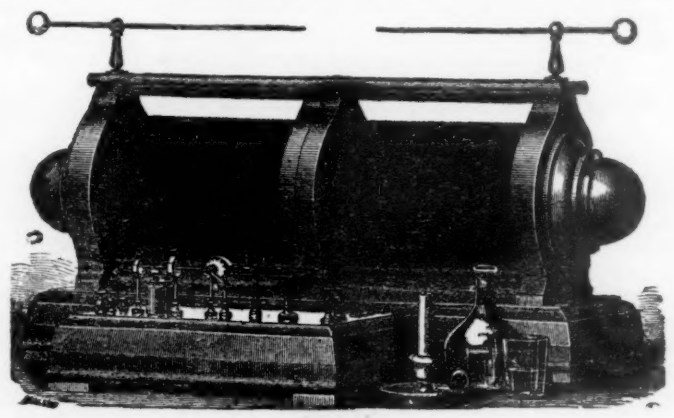

Fig. 6.

three inches thick. These instruments are, however, on account of the amount of wire used, and the careful insulation needed, very expensive. Thus the one shown in Fig. 4 cost $275, and that shown in Fig. 6 $1000. To employ one of them wherever a single gas burner was to be replaced would, therefore, be out of the question on this ground of cost, without considering any other objection.

This same discharge from an induction coil may also be used as a source of light in another way.

If an exhausted vessel, or one only containing highly rarefied gas, is arranged with conductors running into it, as in Fig. 7, and these conductors are connected by wires with the ends of the secondary of an induction coil, then the electricity will pass through the rarefied gas, producing light which will be often arranged in strata, or layers, in the manner indicated in the drawing, Fig. 7.

If the cross section of the vessel is smaller, the light is brighter, and thus, by the use of tubes with wire let into them, very brilliant effects can be produced. Such tubes are called, from their first manufacturer, a glass blower of Bonn, Geissler tubes, and some of the ordinary forms are shown in Fig. 8.

By using different gases, and employing various fluorescent substances, in the surrounding jackets, very beautiful combinations of colored lights are obtained.

I now show you a number of these tubes arranged on a screen, and illuminated at once by the discharge from my large coil.

Some of these tubes you will notice not only emit a bright light while the electric discharge is passing, but continue to glow for some minutes after it has ceased. This introduces us to a new phenomenon of light.

Fig. 7.

When light falls upon certain bodies its vibrations cause changes in the relative positions of their particles, somewhat like the changes which heat vibrations produce in solids when they cause them to melt; for example, ice melted by the sun's rays. When, however, these vibrations cease to act, the changed substance falls back into its previous condition (as when the melted ice again congeals), but in so doing, emits again vibrations like those expended in the former change, but of lower "pitch," or greater wave-length. Just as water in freezing emits heat, of low "pitch," and thus cold, compared with our bodies, but nevertheless heat compared with

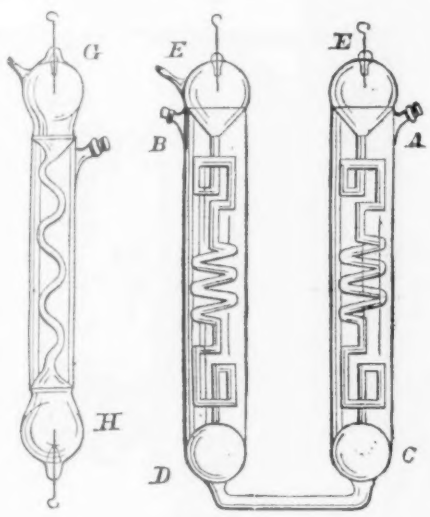

Fig. 8.

a zero of temperature. So these phosphorescent bodies exposed to strong light suffer a change which, in reversing itself, causes the emission of light again, fainter, it is true, and lower in "pitch," that is, of a color nearer the red or lower end of the spectrum, than the exciting light, but nevertheless very appreciable light. Thus violet light, by phosphorescence, becomes blue, green, yellow, or red; blue light becomes green, yellow, or red, and so on.

Such gases as are contained in these tubes are, however, not alone in possessing this property. I have here several solid substances—sulphides of barium, strontium, and calcium—which behave in the same way. We illuminate them by an electric spark, and then they continue to glow in the dark. Superior to them all, however, I find the dial of this clock.

I expose it for a moment to the electric light, and now you see it in the dark from the furthest corner of the hall.

I have analyzed the material with which this clock dial is coated, and I find that it is a sulphide of calcium ("Canton's phosphorus," discovered in 1768), attached by some resinous medium or varnish. Though the substance is therefore in composition, only the old and familiar one above mentioned, its present manufacturers have found out some method of wonderfully increasing its efficiency. One of these clocks exposed for a moment to direct sunlight glows so brightly as to be easily seen in a room which is darkened. This phosphorescence is, moreover, readily excited by lamp or gas light, and one of these clocks will continue to glow during an entire night with no other excitement than that which it gets by the diffused light in a room during the day. Toward morning the glow is faint, but is still sufficient to show the position of the clock hands.

The substances required to make this compound—*i. e.*, lime and sul-

phur—are very cheap, and the French savant, Becquerel, who has elaborately investigated this subject, describes methods of preparing it so that it shall emit light of various colors—orange, green, blue, and violet. If a further advance in brilliancy and duration should be made at all equal to that shown by the clock dials as compared with all former specimens, it is not improbable that this may become a very important substance. If we could paint our walls with such a body it would, as it were, absorb light during the day and then emit it during the night, and it would only be necessary to have curtains to draw over our luminous walls at night to shut out their light when necessary, just as we now draw curtains over our windows in the daytime.

In face of such an arrangement as this, even Mr. Edison's new "electric burner" would be costly and unnecessary. By painting the outside of houses with the same material, all need of street lamps would be avoided.

It is true that "some practical difficulties remain to be overcome," but what are those in these days of inventive power? Should one of our great inventors take the matter in hand and organize a stock company, it will, of course, be merely a question of time and expense in preliminary experiments.

Seriously however, this new form of phosphorescent sulphide of calcium is a wonderful substance, which may well suggest strange possibilities for the future.

ELECTRO-MOTORS, OR INSTRUMENTS FOR PRODUCING ELECTRIC CURRENTS.

In whatever way electricity is to be used as a source of light, there is, of course, no question that a cheap source must be found in order that it may compete with other sources of illumination. As long as the galvanic battery was the only source of electricity, we were met at the very start by the following state of facts.

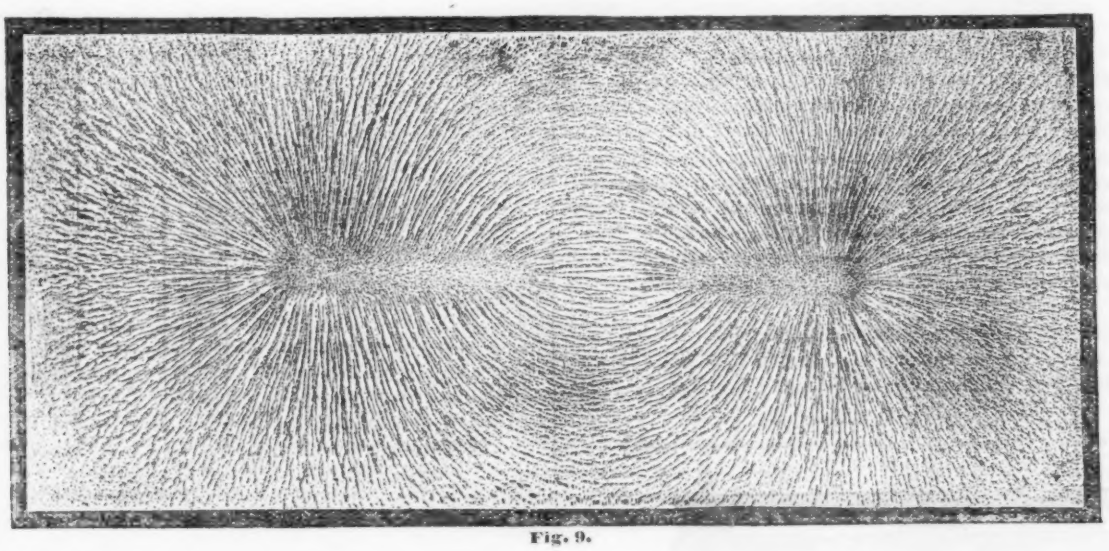

Fig. 9.

The source of energy in the battery is practically the zinc consumed. Weight for weight, coal has almost six times the available energy of zinc; while, moreover, the price of zinc is about 25 times that of coal. In the race between the two, therefore, zinc starts with this enormous disadvantage that an equal amount of energy obtained from it will cost about 150 times as much as if obtained from coal. To make gas from coal, and burn it for light will then be cheaper than to obtain electricity from zinc and turn it into light, unless the loss in the former case is 150 times greater than in the latter.

Batteries, therefore, as sources of electric force for lighting purposes, are out of the question from an economic standpoint.

The possibility of economic lighting by electricity came first to exist when, in 1831, Faraday discovered that the motion of a magnet in relation to a conductor would develop a current of electricity in the latter, and thus that electricity might be developed by the expenditure of mere mechanical energy.

Then, to the coal distilled in the retort was born as a rival (as yet helpless as an infant and unknown), the coal burned under the boiler of the steam engine.

This child has grown slowly or rapidly ever since, and if the reign of the *gas coal* is to end, it will be only to its near relation, the *steam coal*, that it will yield its throne.

It is therefore eminently proper that we should trace the progress of this development in the present connection.

The first principle involved in this subject is this:—

Magnets exert forces in all directions around them, but in such a way that they may be said to be surrounded by "fields of force," in which the forces are distributed in certain directions, known as "lines of force." Some notion of these is obtained if we place a plate of glass over a magnet and then sprinkle iron filings on the former, when on tapping the glass the filings will arrange themselves in certain lines.

A very beautiful method of arranging and permanently fixing such lines has been devised by Prof. A. M. Mayer, and from a plate so arranged by him Fig. 9 has been produced by a process of photographic engraving.

Now it was discovered by Faraday, in effect, that whenever a conductor was so moved in the vicinity of a magnet as to pass through or "cut" these lines of force, a current was developed in the conductor. The greatest effect was obtained when the lines were cut at right angles, and when the greatest number of lines are cut in the same time, either by passing through a denser "field of force" as near the poles of the magnet, or by moving more rapidly. When the conductor moved *along* the lines of force no current was produced.

As the conductor passed into and through the "field" of one pole a current was developed in one direction, and as it passed out of the same field into and through the field of the other pole, a current in the opposite direction was developed. Between the two fields there would, of course, be a neutral point where no current was developed. Indeed, if we turn to Fig. 9 we will see that a conductor, while passing the centre of the magnet, would be moving along the lines of force, and ought, therefore to develop no current, while near the poles it would pass at right angles to the lines of force, and so give a maximum current. At other parts of its path the conductor develops currents of more or less intensity, according as it finds the lines of force more or less oblique to its path.

While the above basis of explanation is very commonly employed in connection with our present subject, it does not seem to me as satisfactory, nor as clear and direct in its relations to the entire subject of electrical induction, as another which I shall now proceed to state.

In the first place, it will be desirable to state the relations between magnets and electric currents first pointed out by Ampere.

According to this theory, a magnet owes its characteristic properties to the presence in the molecules of electric currents all circulating in the same direction.

In other words, if Fig. 10 is supposed to represent a short magnetic bar with its south end toward us, the little arrows would represent the direction in which the currents of positive electricity were flowing in its molecules.

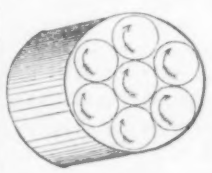

Fig. 10.

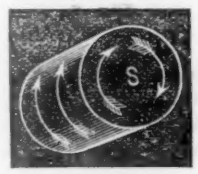

Fig. 11.

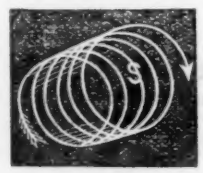

Fig. 12.

The general effect of such currents could evidently be expressed by single currents passing in the entire bar, as indicated in Fig. 11, and the practical effect of such a series of parallel currents would very evidently coincide with that of a current passing through a helix, as indicated in Fig. 12.

As a matter of fact, we find that a helix of wire, through which an electric current is flowing, will exhibit all the properties characteristic of a magnet. Thus, it will attract iron, if freely suspended point north and

south, and if two of such helices are brought together their like ends will repel and their unlike ends attract each other.

This attraction and repulsion, moreover, appears to come under a still wider law, for it may be readily shown that any parallel electric currents, if going the same way attract, and if going opposite ways repel.

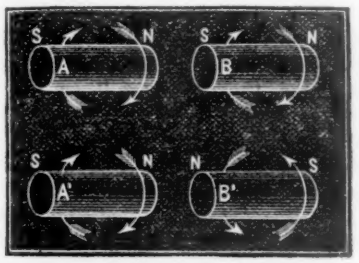

Fig. 13.

Fig 13 shows how this explains the attraction of unlike and repulsion of like poles in magnets.

In A and B, the north and south poles being opposite, the magnetic or electric currents flow parallel and in the same direction, and thus attract in A′ and B′, the two north poles being together, the currents flow in opposite directions, and thus repel.

Another general law must next be stated, namely : Whenever a conductor approaches a parallel current, a mometary flow of electricity is established in the said conductor, opposite in direction to that of the current towards which it is moving ; as the same conductor recedes from the current a momentary flow in an opposite direction is produced.

Let us see how this applies in such a case as we have now to consider.

Let NS, Fig. 14, represent a magnet in which the magnetic currents are flowing as indicated by the arrows on the bar ; if, then, we bring a conductor, like the loop of wire to the right, towards the south end of this magnet, a current will be developed in the loop opposite to the currents in the

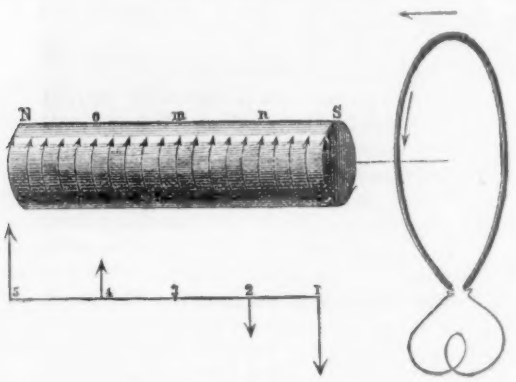

Fig. 14.

magnet, because the loop is approaching all of them. If now the loop continues to be moved forward over the S end of the magnet, when it comes over, say the point n, it will still be approaching many of the magnetic currents, but will be receding from a few, those, namely, which it has already passed. There will, therefore, be an interference between the opposite currents due to the approach to the magnetic currents to the left, and the recession from those to the right, and the resulting current will, therefore, be feeble, although still in the first direction.

When, however, the loop comes over m the number of magnetic currents it is leaving is just equal to that of those it is approaching, and the two currents will, therefore be exactly neutralized.

Beyond m, towards N, however, the current due to the withdrawal from the magnetic currents will predominate and increase until the North end of the magnet is passed.

The horizontal lines with vertical arrows, at the lower part of Fig. 14, represent the directions and relative intensities of the currents developed as the loop moves over the magnet from right to left.

It will be readily understood that it is quite immaterial whether the conductor is moved over the magnet or the magnet is moved through the conductor.

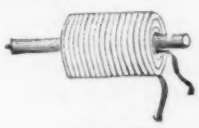

Fig. 15.

Thus, if the conductor is wound into a coil, as in Fig. 15, and the magnet is pushed into or drawn out of it, we shall have a like production of currents.

Or again, if the coil should have in its centre a bar of soft iron, and this should be magnatized by the approach of a magnet, and then lose its magnatism on the withdrawal of the same, this will be equivalent in effect to the sudden insertion and withdrawal of a magnet.

The first attempt which was made to utilize the above-described principles in producing a current of electricity from a magnet by the expenditure of mechanical energy was that by Pixii, of Paris, who, in 1832, produced the apparatus shown in Fig. 16.

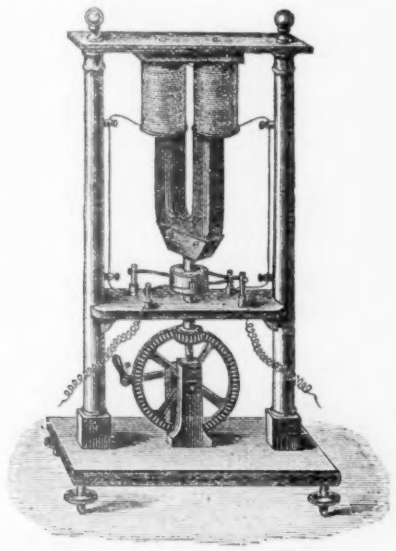

Fig. 16.

Here two coils of wire, with soft iron cores, are supported at the upper part of a frame, while below them a strong steel magnet is made to rotate by appropriate machinery. As each pole of the magnet in turn comes opposite the iron core of either coil, it renders it instantly magnetic, and thus develops a current in the surrounding coil. These currents of course are alternately in opposite directions, and to correct this a "cummunicator" is placed below on the moving shaft, which, by reversing the connections at the right moment, sends the currents always in the same direction through the exterior wire.

Saxton, in Philadelphia, made, in 1833, a modified form in which the steel magnets were placed horizontally, and remained at rest while the coils with their soft iron cores were rotated opposite their ends. Various small modifications followed. Thus, in 1836, Clarke, in London, made a machine represented in Fig. 17. in which the steel magnet was made of several single

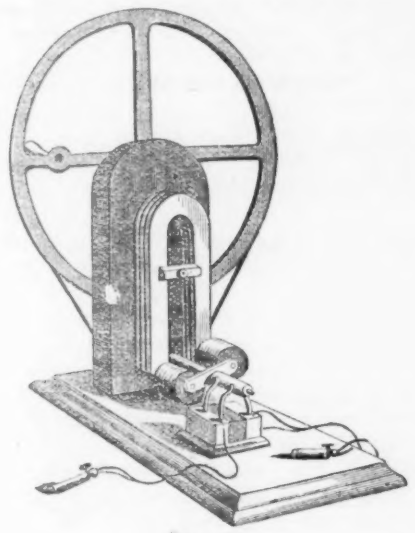

Fig. 17.

magnets united, and the coils were rotated opposite the poles, but at right angles with the plane of the magnets.

Again, Breton wound coils on the poles of the magnet, and then rotated an armature in front. This armature, by its approach and withdrawal, caused movements in the lines of force, or in the magnetic currents which developed momentary currents of electricity in the coils of wire. The relation of this action to Bregnet's apparatus for exploding mines, and to the Bell telephone, is worthy of notice.

Duchenne combined this last plan with the preceding one by winding coils both on the magnet and the armature, and using one or other of the circuits for his induced current.

[To be continued.]

[From the London Journal of Gas-Lighting.

Report of John T. Sprague on the Electric Light.

To the Directors of the Commercial Gas Company.

GENTLEMEN:—I have at your request visited Paris, in order to examine into the present state and progress of electric lighting, with its probable bearing upon the future of gas lighting; and in reporting to you thereon, I propose to treat the subject under three heads—

I. The actual facts—the endeavors made, and the degree of success attained, in producing light by electricity.

II. The relative cost of such light, as compared with gas lighting.

III. The influence likely to be exerted on the gas interest.

I—USES.

There are at present displayed in Paris a great number of electric lights, but they may be studied in a very simple set of groups, based upon the purposes for which they are used. This also happens to properly distribute the different systems in operation.

There are at present two such systems:—that of M. Lontin, in which the ordinary form of electric burner (to use a gas term, as most convenient) is employed; the novelty being in the machine generating the electric current and distributing it to the burners. This is the same system as is used in the Gaiety Theatre, in the Strand. It would be useless to attempt to give now a description of the apparatus used, as this would occupy too much time, but I purpose doing it fully in a publication as early as possible, and which I will send to you.

Jablochkoff's system, on the other hand, consists only in the burner, in which two rods of carbon burn away, side by side; each light, or "candle," as it is called, lasting 1½ hours. Four such candles are mounted on a simple connection in the lantern or opal globe, and provided with what electricians call a commutator, analogous to a set of valves in gas, by which the current can be sent to any candle at will, and so the light can be maintained for six hours. With this candle any suitable form of electric generator can be employed, the Gramme machine being actually used.

Railway Stations.—At the station of the Western Railway Lontin's system is in operation. Two lamps are placed at the principal entrance, and 5 lamps are ranged along the middle of the principal hall, where they replace 34 gas burners, and will no doubt do so to great advantage as far as effect is concerned, for the hall is so large that the gas employed has little power over it. These lights were not in operation when I left Paris, the engine not being ready. The goods department is, however, lighted by six naked burners, worked by one machine and steam engine, the whole working of which I carefully examined. The result is very effective, as the men, loading and unloading, can easily see the addresses on the packages, and the light being distributed around the area of operations (which is, however, a small one), the work is done readily and safely.

Hotels and Shops.—In the large buildings opposite the Louvre, which include a great hotel and an immense series of show-rooms, forming the "magasins du Louvre," a number of electric lights are employed, which contain (as do all the others I shall notice) the Jablochkoff candle. In the courtyard of the hotel, which is roofed in, there are—one lamp in the entrance, which also receives light from one in a window of a show-room; two lamps on one side of the courtyard; and six globes distributed over the staircase which forms the other side of the yard. These lights here replace 14 two-light gas lamps, and 24 single globes upon the staircase.

In this instance I propose to make here some remarks upon the question of cost. It is stated that, including the show-rooms, 201 gas burners, costing 90·4 frs. per day, have been replaced by 16 electric lights, costing only 66·6 frs. per day, being an economy of 30 per cent., with 3½ times the light. Whether in this calculation any charge is made for steam power, depreciation, or interest on outlay, I do not know, but I understand that the work is done by a previously-existing engine. It must, however, be remembered that the Paris gas costs twice as much as London gas, and is of lower illuminating power. Correcting the figures, therefore, in London, the cost would be 35 per cent. greater than the gas; besides which the cost of the apparatus and working would be heavier, and so increase this per centage.

The Streets.—The light it used in many places, but I shall speak only of the Place and Avenue de l'Opéra, which form a roadway some 900 yards long by 30 wide, offering, from the present aspect, one of the most interesting sights of Paris. In front of the Opera there are two columns, carrying each three globes. In the Place there are four columns, each carrying a lantern in which two candles burn together. In the Avenue there are 36 globes, irregularly distributed. In the square of the Théâtre Francaise there are two circles of six globes, and two single ones. There are thus, in one view, 64 electric lights, and, as may be supposed, such a sight is not a little striking, considered simply as a sight. Besides this, there are innumerable shop lights, and although by the effect of contrast the gas-light seems to be nearly extinguished, or swallowed up, by the electric light, they none the less contribute their due share of illumination.

When the beautiful total effect is analyzed, however, we find some things which will somewhat surprise both the casual observer, who goes away exclaiming that such a light must be introduced everywhere, and those who think only of the vivid character of the electric light itself.

It will naturally be supposed that two electric lights, placed only 40 yards apart, will illuminate perfectly the intervening space. On the contrary, a distinct gradation of light, approaching to comparative shade, is observable on the roadway, just as with gas-lights.

People talk about the electric light in the streets superseding the shop lights as daylight does. On the contrary, not one single shop light has been put out. I spoke to one jeweler (besides several other shop-keepers) whose front was directly facing an electric lamp, five yards distant. He still used the ordinary outside lights, and, when I asked him if he found the electric light of use to his shop, he replied, with the usual French shrug, "Why, sir, it is simply moonlight." This is, in fact, the exact description of the effect; the lighting of the street is that of a moderate moonlight, equally distributed, and the eye is caught by points of greater brilliance.

The light is fluctuating. Each candle is continually flashing and changing at times to a rosy tint. This would not be noticed by a casual observer, being lost in the general impression, but on testing the effect by writing directly under a lamp, the light varied to, I consider, fully one-fourth of its maximum power.

The light is rapidly lost in the distance. There is a row of lamps in front of the House of the Legislative Assembly, which lights up the facade very effectively. In the Place de la Concorde these lights stand out vividly from the surrounding gas lamps. At the front of the Madeleine, double the distance, they were distinguishable from these gas-lights only by their greater whiteness, the Paris gas being very yellow. This observation will no doubt seem incredible to many, but I have made some calculations which prove that my sight and judgment told me the actual truth.

The Theatres.—The Hippodrome, a very large circus, is now lighted up with the Jablochkoff candles. There are 20 globes on the boundary line of the arena and the audience; between these there are also columns carrying three gas globes turned toward the seats; above there are 16 naked lights with reflectors, throwing the light on the middle of the arena. There are thus 36 electric lights in full action, and in addition there are four naked lights suspended from the roof, and employed during the trapeze performances. But with all these powerful lights the result was poor compared with the rich radiance we are accustomed to in theatres. As in the streets, it was an effect similar to moonlight, and the fluctuations in the lights were very perceptible. I was greatly surprised at this, as I was prepared to find the light especially suited to this purpose. I can only explain the actual fact by supposing that the eyes are dazzled by the number of cross-lights, directly influencing them, instead of illuminating principally the objects intended to be seen.

II.—THE COST OF THE LIGHT.

As to this, it ts impossible to obtain any real definite information. We can only take at a suitable discount the statements of interested parties. It would be useless to describe the machines for converting mechanical energy into electricity and light, but they are costly.

The price of the Gramme machines used with Jablochkoff candles at present is £400 for the size working 16 candles; the fittings of each lamp cost £8, and the two conductors together 3s. 6d. per yard of distance. The expenses of fitting up are to be added, and the prices, being at Paris, would be a good deal higher here. Besides all these, an engine of at least 20-horse power must be provided.

The hourly cost of working is stated at 8s. 8d. per light, to which must be added an allowance for depreciation, repairs, and interest.

Making the very best of it, the expense cannot be less than 8d. per hour per light; but any calculation based on this, without taking into consideration the circumstances of any particular case, would be so vague that I shall confine myself to the one distinct statement agreed to by all the interested parties—that each single light consumes one- horse power of an engine, besides all the incidental expenses.

In the London system, I believe that the first cost is less, add also the working expenses, to some extent. But I know that the light exhibited at the Gaiety tries to the utmost the power of a 12-horse engine.

The light produced is stated at 100 Carcel lamps for regulators, and 80 for candles. There is some doubt about the value of the Carcel lamp in our standard candles; but Mr. Sugg values it at 9·5, and I will use this value as being the highest.

This gives us 950 candles for the one, and 760

for the other light, both naked. I greatly doubt this value. I found no difficulty in steadily examining the lights at a distance of 12 or 15 feet, and cannot believe that my eyes would endure the light of 760 candles gathered into a point no larger than a sixpence.

The lights are actually used in opal glass globes, which are said to absorb one-third of the light. The best experiments, I believe, show that—

Plain glass absorbe.....	10	per cent.
Ground "	30	"
Opal "	60	"

This would give the actual light (taking their own value for the candle itself) as 300 standard candles.

Ordinary gas, properly burnt, will give at least the light of 14 candles for 5 feet per hour—that is to say, 1,000 feet give, for one hour, a light of 2,800 candles, at a cost of, say, 3s. 4.

Assuming that the electric candle gives the 300 candles, and that its cost per hour is only 8d., the cost of the same 2,800 is 6s. 2½d.—that is to say, that, for equal quantities of light, the electric candle costs, on the figures of the interested parties, nearly twice as much as gas does; and to obtain this result, all the trouble and risk of machines and engines must be incurred, as compared with the simple turning on of a tap.

On the other hand, the electric light has well-known advantages, and, further, these figures are but approximate values for results already attained, while it cannot be doubted that greater improvements will be made. In fact, I am cognizant of, and have seen in operation, a machine very much simpler and less costly than those now used, and which, as far as I can judge, will take considerably less power to work it. But the same remark applies to gas, for there is wide room for improvement in the burners and fittings to enable the gas to do its work. One of the effects of the excitement about the electric light will be to stimulate endeavors in this direction.

III.—Influence on Gas Interests.

Turning now to the influence likely to be exerted upon gas interests, it is very evident that the electric light has a place to fill, in which it has advantages over gas, and in which it must be expected to gradually replace it. But it is also evident that such uses are limited by the cost of working, by the large outlay involved, and by the specific nature of the light.

We cannot limit the inventive faculty, but their is little probability that the electric light will be adapted to domestic uses. For street lighting, some very great advances must be made in the direction of economy beyond what has yet been done before their is much chance of seeing electric lights used, except possibly a few crowded crossings, such as Charing Cross or Oxford Circus. The case is not to be compared with Paris, where, as before stated, the relations of cost are also very different. Paris is a great fair or bazaar, and the people live in the streets, which are filled with beautiful buildings and manifold sources of attraction. Abundant light is as much a part of their stock in trade as it is in our public-houses, and it pays them to disregard its cost. Neither our climate, cities, nor habits of life are the same, nor do they offer us inducements to adopt the same course as would suit Paris, where the gas-lighting is so profuse that in the Rue dg la Paix, for instance, the lights are equivalent to one good burner every 4½ yards. The illumination there, if not so vivid, is, practically, quite as useful as the electric light in the adjoining Avenue, in which an exactly similar system of lights was, and still is, used after midnight.

In railway stations, large halls, and in manufactories, the light will no doubt be used, but its introduction will be gradual, and its utmost effect will be to reduce the annual increase of consumption of gas; it is not likely to touch the actual consumption by which dividends are earned.

On the other hand, there is a nearly new field opening for gas in the form of gas engines. These are receiving great improvements, and from their safety and convenience, and from the fact that they require scarcely any attendance, are destined to replace steam engines to a great extent. In fact, should the electric light come into much use, it is most likely that gas will be called upon in very many cases to supply the motive power. There are other undeveloped uses for gas which will compensate for any amount of reduced consumption at all likely to result from the electric lighting.

Finally, it needs no prophetic power to foresee that ere long a dead set will be made in the market, both upon gas shares and upon the pockets of the British public, the natural prey of the "promoter." Many timid shareholders will sell, as always happens under similar circumstances, and it is highly probable that shares will suffer for a time a reduction in price.

But I feel no hesitation in expressing the conviction, after full examination of the subject, that the gas companies of London have nothing whatever to fear, and that whatever may happen to gas shares, owing to market operations, gas dividends will not suffer the reduction of a shilling by any competition with the electric light.

I am, etc.,

John T. Sprague,

Member of the Society of Telegraphic Engineers.

[From London Journal of Gas-Lighting.]

On the Testing and Valuation of Gas Liquor.

By Mr. T. H. Davis.

Gas liquor, as the majority of our readers are aware, is produced as a bye-product in the manufacture of coal gas. The crude gas, on leaving the retorts, having been deprived of its tar and a portion of aqueous vapor in passing through the condensers, is conveyed through pipes to a washer, or a scrubber, the former being a vessel through which the gas bubbles, and the latter an upright tower filled with coke, over which a stream of water flows. In the passage of the gas, therefore, through either of these, it is exposed to a considerable surface of water, and by this water the ammoniacal compounds, existing in the crude gas in a state of vapor, are absorbed. This water, containing salts of ammonia in solution, is allowed to mix with that condensed in the condensers, and the whole product is called gas water, gas liquor, ammoniacal water, or ammoniacal liquor, all these terms being synonymous.

The liquor thus formed has a specific gravity ranging from 1·005 to 1·070, or even 1·100, or, in other words, from 1° Twad. to 14° or 20° Twad., and in color varying from straw color, through various shades. to dark brown, some samples being quite clear, and others more or less thick and turbid.

This is the liquor from which nearly the whole of our ammoniacal compounds are formed, and hence it must be considered as a valuable product, especially (as will be shown hereafter) that the compounds of ammonia, which it contains in solution are, in great part, decomposed by mere boiling, and wholly, if the liquor be mixed with lime previously. This liquor has been, and now is, in almost all cases, bought and sold on the basis of its specific gravity, or, in other words, on its degree Twaddel; but I hope to show the fallacy of this test—as has already been pointed out by my friend, Mr. Geo. E. Davis, in a paper which he read before the British Association of Gas Managers this year—for surely the time has come when such empirical methods of testing and valuing such valuable products should no longer exist. The specific gravity of a liquor does, it is true, give a rough indication of its strength; that is, a liquor standing at 5° Twad. would be considered to be a more valuable one than one standing at, say 4° Twad., and less valuable than one which stands at 6° Twad. . but on examination of the table given below, it will be seen that the degrees Twaddel should not be relied on, for one manufacturer may purchase a liquor standing at, say, 4° Twad., and another, at a higher price, one standing at 5° Twad., and yet it is quite possible that the first may contain as much, or more, ammonia than the one at 5°. The following table, which contains a few results taken from a great number, will show this in a clearer manner:

NH_3 per Cent.

3° Twad.	4° Twad.	5° Twad.	6° Twad.	7° Twad.
1·00	1·74	1·97	2·31	2·39
0·92	1·66	1·89	2·15	2·29
0·84	1·28	1·56	1·88	2·23
—	0·84	1·49	1·65	—

These percentages of ammonia were determined by a simple titration method which I have used for some years. I presume it is known to most of our readers, but for the benefit of those who may not be acquainted with it I have fully explained it further on.

Some companies have it is true, made an attempt to supersede the test by Twaddel by one which is more chemical—namely, by selling the liquor on the basis of the number of ounces of sulphuric acid required to neutralize a gallon of it, the results obtained being stated as a liquor of so many ounces strength. Thus, a liquor which required 10 ounces of acid to neutralize a gallon of it would be called a 10-ounce liquor, and so on; and it happens in many cases that the number of ounces required is about twice the number of degrees Twaddel; but this rule must not in any way be depended on, although some manufacturers base their calculations on it. I have given a few results from my note-book, expressing in the first column the degrees Twaddel, in the second column the acid strength or number of ozs. of sulphuric acid required to neutralize a gallon of the liquor, and in the third column the degrees Twad. multiplied by 2:

Degs. Twad.	Oz. Acid.	Twad. × 2.
5·25	11·38	10·50
4·80	10·06	9·58
5·00	8·91	10·08
5·50	10·11	11·08
4·80	7·29	9·58
6·10	10·20	12·20
5·70	8·78	11·36
6·00	11·50	12·00
6·00	9·53	12·00

Here we see at once, even in this rough method the fallacy of the degree Twaddel as giving the data for a fair and proper valuation of the liquor, for, of course, the ounces of acid required represent its value in a much fairer way than does the physical test of its specific gravity.

I think I may say with safety that as long as a manufacturer bases his calculations on the spe-

cific gravity test, he must never expect them to turn out true ones.

This test, then, receiving condemnation, what test shall be suggested to take its place? It must be one that can easily be done without much trouble with apparatus, and one that can be performed quickly. Obviously, as the ammonia is the article the manufacturer desires to obtain, it should be also the basis of the test for valuation—that is, the liquor should be bought and sold on a sliding scale, at so much per ton for each per cent. of ammonia it contains; then the manufacturer will know what he is buying, and the gas companies what they are selling. Moreover, the manufacturer will also know the quantity of ammonia he is received into his stock, and can work his calculations as to the quantity of finished product he may expect, whether it be sulphate or chloride of ammonia, or liquor ammonia, with confidence and satisfaction.

Now, to determine the quantity of ammonia (as NH_3) in the liquor, my friend, Mr. G. E. Davis, recommends the distillation process, which consists of boiling a certain quantity of the liquor with lime in a flask arranged in a manner well-known to us all, and passing the vapors into a known volume of standard acid, titrating back, at the end of the experiment, with standard soda. This we know to be a correct test, but, unfortunately, to be correct, it requires a considerable time, each test taking the best part of an hour.

Before a contract is made between a manufacturer of ammoniacal products and a gas company, this test should be carried through, so as to get at the actual quantity of ammonia to be obtained from the liquor; but I should not recommend a contract embracing this test, for when each separate lot of liquor arrives at the ammonia-works, it would have to be subjected to that test in order to see that the delivery is of equal per centage to that stipulated for. Now, in large works, as I know from personal experience, many separate lots of liquor from the same or different gas-works will be arriving every day, each of which will, of course, require to be submitted to test; consequently, if the distillation process were to be adopted, the time occupied would be more than could be spared in a works laboratory.

As far as my experience shows me, the direct titration of liquor with normal sulphuric acid and calculation into ammonia would be a test sufficient to base a contract upon, and for the guidance of the manufacturer, and for all practical purposes, it may be looked upon as correct. Moreover, each test does not take five minutes, whereas, as I have before stated, the distillation process takes the best part of an hour.

The titration method of testing is as follows; Into a flask, of about 300 c.c. capacity, 10 c.c. of the sample to be tested are run, and into this 15 c.c. of normal sulphuric acid. The contents of the flase are then raised to boiling over a naked flame, a few drops of litmus added and titrated back with normal soda. The number of cubic centimetres of soda used are deducted from the 15 c.c. of acid employed, the result multiplied by 17, and divided by the specific gravity of the liquor. The result thus obtained represents the per centage of ammonia contained in the liquor. An example will make this clear:—10 c.c. of a liquor at 5° Twad. (sp. gr.=1025), boiled with 15 c.c. normal acid, required 5 c.c. normal soda to neutralize it, consequently the sample contains 1·658 per cent. NH_3; thus—

$$\frac{(15-5)\times 17}{10{\cdot}25}=1{\cdot}658$$

Now, as to the valuation. Suppose we consider that 10s. per unit of NH_3 per ton to be a fair value, then the above sample would be worth $1{\cdot}66\times 10{\cdot}5=17$s. 5d. per ton. Of course I do not wish to fix any price as the standard for valuation—that must be a matter of arrangement. Such a system would induce gas managers to make the liquor as strong as possible, and ammonia manufacturers would do well if they were to refuse a contract for liquor containing less than one per cent. of NH_3; for if below this—unless the liquor were given them—they would hardly clear the expenses of manufacture.

I trust this paper will cause other chemists who have had experience in the matter to express their views on the subject, for I cannot but think that all such would be glad if such rule-of-thumb methods as are now employed in this branch of chemical manufacture were abolished.

Omission Corrected.

In the report of "members present," at the Sixth Annual Meeting of the American Gas-Light Association, as given in our last issue, we unintentionally omitted the name of George S. Hookey, of Augusta, Georgia. We regret that such a mistake should have occurred, and more especially with reference to this gentleman who, as all know that are in the habit of attending the meetings, is *always* on hand when anything is to be done to advance the science of gas manufacture.

Tax the Scrip.

CORPORATIONS NOT TO ESCAPE BY MAKING NOMINAL DIVIDENDS OF IT.

Important Decision by the Supreme Court, General Term, in the Matter of the Williamsburg Gas-Light Company—Text of the Opinion by Mr. Justice Gilbert.

The decision of the Supreme Court, General Term, in review of the appeal of the Williamsburgh Gas-Light Company from the assessing of its scrip by the Board of Assessors, is of great importance, as many corporations have escaped taxation of their surplus by making nominal disposition of it among their stockholders in the form of scrip dividends.

It appears that by resolutions of the board of directors of the Williamsburgh Gas Light Company, passed in Jannary, 1870, Jannary, 1871, and July, 1871, scrip dividends were authorized to be made to the stockholders to the amount of $1,000,000, and in proportion to the stock held by them respectively. The scrip is in the form of certificate, declaring that the holder "has an interest in the property of the Williamsburgh Gas-Light Company to the amount of —— dollars, upon which the Company promises to pay interest, etc.," and the certificates contain a provision for redemption in money or stock, at the option of the directors, and whenever they appoint, but not before.

The Assessors determined that these certificates were only colorable debts, and represented in fact surplus profits or reserve funds, still retained and used by the Company, liable to its creditors, and the proper subject of taxation. The company sued out a writ of *certiorari* for the review of the proceedings of the Assessors by the General Term. On the argument the Company was represented by Messrs. Rolfe & Bergen and E. M. Cullen, and the Board of Assessors by John H. Knaebel, Assistant Corporation Counsel.

The counsel for the Company contended that the certificates do not represent surplus profits or reserved funds, but a mere debt to the stockholders and their assigns; and that they represent money expended out of the earnings of the Company during many years, in improving their property and extending their mains, and which properly belonged to the stockholders as profits.

Mr. Knaebel contended that the issue did not create a debt; that it was beyond the power of the directors to authorize it; that it did not amount to a gift, because the thing assumed to be given was not delivered; and that as a contract it was without consideration and was void, not only as to creditors, but as to the taxing power, which, overlooking the form of the certificates, might lawfully assess the assets of the Company wherever they could be found, and might fairly hold the certificates to be evidence of the existence of the "property" to which they expressly refer.

The opinion of the General Term affirming the proceedings of the Assessors is written by Justice Gilbert.

THE OPINION.

GILBERT, J.—The assessment roll not being before us, we cannot tell whether the Assessors conformed to the statutory directions in making up the same. Nor is the question a material one in this proceeding. Substantial error must be shown before the Court can interfere with the tax. A mistake of the Assessors in the form of the assessment is not enough. (The People *ex. rel.* U. and B. R. Co., 6 Hun, 556.) The sole question in the case remaining is whether the relator is liable to be taxed for surplus profits or reserved funds. The statute on this subject makes the capital stock of the relator, except such part of it as shall have been excepted in the assessment roll, or as shall have been exempted by law, together with surplus profits or reserved funds exceeding ten per cent. of its capital, after deducting the assessed value of its real estate, and all shares of stock in other corporation, actually owned by such company, which are taxable upon their capital stock, liable to taxation at its actual value. (1 R. S., Edin. Ed. 374 *et seq*—3 id. 373.) In its statement made to the Assessors, pursuant to the requirement of the statute first cited, the relator stated that it had no surplus profits or reserved funds. Nevertheless, the Assessors set down those items in the assessment roll. That the Assessors had a right, and it was their duty to do, provided they had evidence before them which controverted the statement of the relator. The relator, after delivering its statement aforesaid, furnished other evidence respecting its surplus profits and reserved funds, upon which the Assessors acted, and we deem that evidence sufficient. The case shows that in the years 1870 and 1871 the relator issued to its shareholders respectively certificates amounting to the aggregate sum of $1,000,000. Each certificate certifies that the stockholder has an interest in the property of the relator to the amount stated therein, upon which amount the relator promises to pay interest at 7 per cent. per annum, in semi-annual payments, and also states that the relator reserves the right to redeem the certificate by paying the amount thereof, at the option of the relator, in currency or in stock of the relator at par. The Assessors treated those certificates as evidence that a fund existed which was represented by those documents. We do not see how they could have acted otherwise consistently with their duty.

The certificates state that the persons to whom they were issued have an interest in the property of the company. Such persons, before they received such certificates, had a ratable interest in all the capital of the company, and such an ownership

CARRIED WITH IT A RATABLE INTEREST

in its surplus profits and reserved funds. The certificates conferred no additional interest, but merely declared that which the law would have allowed without them. The counsel for the relator cites the case of Bailey vs. R. Co., 22 Wall, 604; and Brown vs. Lehigh Coal Co., 49 Pa, 720; to show that the issue of the certificates was legal, and that they operated as actual dividend of surplus profits or reserved funds. The Court of Appeals, in Brundage vs. Brundage, 60 N. Y., 547, declined to pass upon the legality of the scrip referred to in the case in 22 Wallace. This case can be disposed of without deciding whether the

certificates are valid or not. We shall therefore express no opinion on that subject. The cases cited do not countenance the proposition that such certificates make an actual division of an existing fund. They merely recognize the obligation created by scrip payable out of future earnings, and ultimately redeemable in stock issued by corporations which were restricted as to current dividends. Such scrip is very different from the certificates in this case. In whatever form the property to which such certificates referred existed, it was in contemplation of law surplus profits or reserved funds. It could not properly be placed under any other general designation. Property of a corporation must necessarily consist of capital, or surplus profits, or reserved funds. Money paid in and used, which cannot be withdrawn and divided among the stockholders of the company, is capital. Surplus earnings or net profits which have been accumulated over and above the capital, cannot be included in capital. They properly fall, therefore, under the other designation. The form in which capital is invested does not change its nature or functions. Nor does an investment of surplus profits or reserved funds make them anything else. [Mutual Insurance Company vs. Supervisors of Erie, 4 Coms. 442; People vs. Supervisors, 4 Hill, 20; Bank of Utica vs. City of Utica, 4 Pai., 399; People vs. Supervisors of New York, 18 Wend., 605] If it had been shown that the fund which the certificates represent had been expended in purchasing real estate or in improving that which had been before purchased with capital or otherwise, a different question would have been presented, for real estate forms a distinct subject of taxation. But that fact—if it is one—does not appear. A loss or dissipation of the fund or any part thereof by a destruction or depreciation of the property in which it had been invested, would also have entitled the testator to be relieved *pro tanto* from the tax. But no such casualty was shown or pretended. The statute regulating taxation was amended in 1853, so as to include surplus profits or reserved funds, for the reason, no doubt, that such property was not included in the word capital (Lawrence Tax Laws, 26—29, Owego starch factory vs. Dolloway, 21, N. Y. 449—445, *et seq*, People vs Dolan 36 N. Y. 62),

It seems to me to be impossible to maintain the proposition that the certificates referred to constitute an actual dividend of the relator's surplus profits or reserved funds. As before intimated, those certificates merely designate the interest of the respective stockholders, or, if they have been transferred, of the transferrees, in that portion of the surplus profits or reserved funds, which such certificates represent. Whatever property the relator held as surplus profits or reserved funds at the time such certificates were issued, it continued to hold afterward, and for aught that appears before us, still holds. The legal title thereto remained vested in the relator, notwithstanding the certificates. No property nor any right to the specific use of money passed thereby, and no debt against the relator was created by them. Supposing them to be legal, they are simply the muniments and evidence of the holder's interest in a given share of property of the corporation. (Sun Mut. Ins. Co. vs. the Mayor, 4 Seid. 241; Mich. Bank vs. N. Y. & N. H. R. Co., 3 Ker., 627 *et seq.*; Bailey vs. Railroad Co., 22 Wall, 636 *et seq.*) It seems to me, however, to be immaterial whether they can be considered a debt in any sense or not, for the debts of a corporation are not to be deducted from its surplus profits or reserved funds in order to ascertain the amount of the latter for the purpose of taxation. The certificates themselves may be liable to taxation in addition to the funds represented by them. But so are the shares of stock held by a stockholder, notwithstanding the corporation has been taxed on the property which those shares represent. (Van Allen vs. the Assessors, 3 Wall, 573, 583–4, People vs. Kennedy, 35, N. Y., 423, City of Utica vs. Churchill, 33 id., 237.) The issuing of the certificates may, (but probably will not), subject the holder of them to taxation upon them in addition to that on his shares of stock, but as the value of those shares ought to be diminished, by the amount of the certificates, no apprehension of injustice ought to be indulged on that account.

If we are correct in the views expressed, the tax does not exceed that which the relator is liable to pay. The proceedings should, therefore, be affirmed, with costs.—Brooklyn *Daily Eagle*, Dec. 11th.

[From London "Journal of Gas Lighting."]

West of Scotland Gas Managers' Association.

The Thirteenth Half-Yearly Meeting of this Association was held on Thursday, Oct. 26, in the Town Hall, Kilmarnock—Mr. Samuel Stewart, Engineer of the Greenock Gas Works, President of the Association, in the chair. There was a large attendance of members.

Mr. R. S. Carlow, Secretary of the Association, read the minutes of the previous meeting, from which it appeared that at a meeting of the Committee recently held, a sub-committee was appointed to watch the progress of electric lighting, and report at a meeting of the Association.

On motion of the President, the minutes were adopted.

Financial Position of the Association.

Mr. Carlow, on the suggestion of the President, then submitted an abstract of the financial position of the Association, from which it appeared that, after paying all accounts, there remained a balance in his hands of £9 8s. 8d., and that at the present moment the benefit fund amounted to £103 2s. 6d.

The statement was received with applause.

Admission of New Members.

The President—The next business is the admission of new members, and we have the following gentlemen to propose:—

Extra-ordinary Member.

Wm. Logan, Castlecary Brick Works, by Cumbernauld.

Ordinary Members.

Frank Scott... .....Gas Manager, Tillicoultry.
Andrew Scott.....Gas Works, Galashiels.
Robert Miller.....Gas Manager, Innerleithen.
James Black..... " Kirk, Fieldbank
Alexander Winton.... " Grangemouth.
James Hamilton..... " Skelmorlie.
Thos. Wilson..... " Saltcoats.
Daniel M'Kenzie .....Dalmarnock Gas Works Glasgow.

On the motion of Mr. M'Gilchrist (Dumbarton), seconded by Mr. Mitchel (Coatbridge), the names of the above gentlemen were unanimously added to the list of members.

The President then delivered the following

Inaugural Address.

In commencing the more important proceedings of this, our half-yearly meetnig, it is my first duty to thank you for the honor you have done me in electing me to the position I now occupy as your President; and before entering upon other matters I shall refer for a brief space to the present position of the Association.

Although only established toward the end of the year 1872, we have now 140 ordinary members and 40 extra-ordinary members, showing the Association has had a very vigorous growth so far; and from the financial statement which has been read to you, it will be seen that financially also the Association is in a very gratifying condition.

This Association was commenced with the object of bring together the younger members of the profession, and those in charge of the smaller gas works; but the very great attention that is shown to the proceedings of this Association by the members of the more important ones connected with the manufacture of gas in all parts of the United Kingdom, is sufficient to show us that ours holds no secondary position.

The very important character of the papers that are from time to time read and discussed at our meetings, and the valuable inventions which several of our members have brought before gas manufacturers—inventions relating to every department of the manufacture and distribution of gas—could not do otherwise than create an interest in our proceedings, and it will be seen, from the papers which will brought before us to-day, the members are determined to keep up the character of the Association.

At the same time, I have to regret that there is always considerable difficulty found in getting papers, and I would earnestly call upon all present, whose opportunities will allow of it, to contribute, by papers giving the result of their experience or studies, so as to keep up the importance of the Association.

It is also necessary that all should freely enter into the discussion of the papers brought before us. To-day we will have read, for our information and discussion, valuable papers prepared by Messrs. Young, Aitken, Fairweather, and other friends, all of which are of great value; so that, although the number of papers to be read is not great, still the smallness of their number will be amply made up for by their excellence, all giving information which will possibly have an important bearing on the future of gas making.

It is not usual, I notice, from the reports of your previous meetings, for the Chairman to extend his remarks to any great length at the first of the half-yearly meetings in each year, and I will therefore endeavor to make my remarks as brief as possible. The subject that deserves our most serious consideration, and one that is receiving very considerable attention among scientific men, is that of lighting by electricity.

From the reports that appear from time to time, it will be observed that experiments have been made in the lighting, by this means, of open spaces, such as squares, wide streets, and large workshops; and, although these experiments have been attended with more or less success, still the electric light is found very far from being either reliable or agreeable. The apparatus used in producing the light is liable to get suddenly out of order, causing total darkness at any moment, and the light is found to be so intense as to be both inconvenient and dangerous from the intense glare when looking at it, and from the very strong shadows that are thrown. Endeavors are being made to overcome these deficiencies, and various means are being adopted for tempering and softening the light; and, on looking at the rapid strides scientific research is now making, there is little doubt that, so far as lighting large spaces is concerned, these efforts to make the light available will have a certain measure of success. But, so far as the matter has yet gone, the expense of producing the light is so great that its use can only be indulged in when cost is not of such great moment as that a strong light may be obtained.

No attempt, or at least no success has as yet attended any attempt to make the electric light available for domestic purposes, and at present there seems little chance of the light being used in dwelling houses. Indeed, the whole subject is, for all practical purposes of daily use, in a very crude form; and it is likely to be some years before it can be brought to that state of reliability, or be produced so cheaply, as to enable it to compete with gas in the general lighting of towns. Still, we have seen too many wonderful discoveries of late years to doubt of its ultimate success some time or other, and it becomes us, not only as a scientific Association, but as one especially devoted to the subject of the public lighting of towns, to give the matter our most serious consideration and study.

We have to look to the electric light as one that will eventually compete with gas light. Gas has

hitherto outstripped all competitors, whether oil, paraffin, or wax or other candles—all these methods of lighting, when cost, convenience, and general utility are taken into account, have had to give way to lighting by gas; and it will now become us to devote our attention more than ever to all the various details in the manufacture of gas and the perfection of its distribution, so that every point may be taken advantage of, both to cheapen the first cost of manufacture and to ensure its delivery to the customers with as little loss or waste as possible, and also not only to so improve the quality, as far as purity is concerned, but also so to improve the methods of consuming gas as to enable it not only to be burned with as little waste of light as is possible, but also with economy.

The lighting of streets and squares is not usually one of great profit to gas companies, so that competition there is of less moment than the lighting of houses; still, it is a department of public lighting that we would be unwilling, as a rule, to lose, although there are cases were gas companies would willingly get rid of it, as it is often a cause of dispute between gas companies and corporations. And in the cases of corporations who make their own gas, it will be a long time before they find it possible to light their streets so cheaply or so simply, by any other means, as by that of gas-light; for, as a question of cost, it must be borne in mind that, although as a matter of accounting they may charge themselves for gas in public lamps at the same price as they charge consumers, still, as the profits go into the pockets of the public—either directly, as profits, or by selling gas at a cheaper rate than would be the case if the charged themselves with the net cost of the gas—it is practically the same as if they only charged street lamps at prime cost.

To advise that all possible economy be exercised in first cost of producing gas, and saving of waste in its distribution, is a simple matter, but how it is to be done is quite another thing; for I may assert, without fear of contradiction, that there is no member of this Association who does not do all that is in his power to do, either by hard work or mental anxiety, to make the gas he has to supply as cheaply, and to distribute it with as little waste as possible under the various circumstances with which he has to contend. It is not, however, only by direct hard work and anxiety that economy is to be effected, or the first cost of production is to be cheapened, but by mutual intercourse of opinion and relation of experience given in discussion, and by adopting the various improvements brought out from time to time. It is seldom that any improvement is brought out that effects a great direct money saving, but a small saving in one department and a small saving in another, effected throughout the whole details of gas supply, put together, in the end permit of a considerable saving in the annual working being shown.

My impression is that one of the most likely directions for us to look for increased profits is by endeavoring to increase the returns from residual products; for in all works their is room for improvement, and in many works a great deal of room for improvement in this respect.

To refer shortly to one item of these—viz., coke. Unfortunately, from the low value of this with us, any saving that may be effected in setting retorts, or economy of heat in the use of fuel, will not give results of great value: but it is worthy of consideration where circumstances will permit of it, to endeavor to ascertain by direct experiment if it would not effect a money saving to entirely alter our present system of heating retorts, and endeavor to do so by regenerator furnaces; at present, large quantities of heat pass unappropriated to the chimney, which, if utilized, would effect a saving of fuel. There is no novelty in the use of these furnaces as they are employed on the Continent for heating retorts, and in this country in the manufacture of iron and other purposes.

Unfortunately, in the majority of works in charge of the members of this Association, circumstances will not admit of the present system being altered; still a saving of heat would be effected by so constructing the oven as to retain the heat within themselves, instead of it passing off through the retort-house, to the discomfort of those employed there. But in the most important matter of the carbonizing of coal, there is ample room for study, and the question is, whether we are taking the best means, from an economical point of view, of distilling coal, by endeavoring to produce the whole of the illuminating constituents in the coal by a single process; and I think it will be allowed, from the information laid before us as the result of ample experiment and study, that the best results, even with the most careful selection of mixtures of cannel, cannot be produced by a simple distillation of the coal. We know that by working by high heats and prolonged charges, or by passing the gas, as it leaves the charge, over highly-heated surfaces, that comparatively large yields of gas can be produced; but,, at the same time, from the large quantities of non-illuminating gas produced, the average illuminating power of the whole charge is low, and the high quality of gas we have to supply can only be obtained by the use of a large proportion of rich and expensive cannels. While, on the other hand, by working at short charges and moderate heats, and afterward subjecting the tar and fluid hydrocarbons to a second distillation at a low heat, permanent gases of a high quality can be produced from inferior and cheap cannels, and much more economically than by the present method with the use of rich cannels.

The difficulties that present themselves to most minds in adopting this process, is the fear that, in consequence of the naphtha being removed from the tars, it will affect their sale; but I think that there need be no fear of this, for although they may be of less value to tar distillers, yet there are other buyers who will readily purchase them. Those gas managers who work up their residuals find no difficulty in disposing of the tar after the naphtha is removed.

There is another department of the process that I think does no receive in this country that amount of attention it should—viz., the scrubbing department. In many works scrubbers are not used at all, and in others they are employed in a most inefficient manner. The difficulty, of course, is the want of steam power; but if gas managers were fully alive to the serious loss they suffer from the want of efficient scrubbing power, there is no doubt means would be found for effecting an improvement in the department of purification. There is no difficulty in arranging a scrubber that will work at a very moderate pressure without the aid of machinery, either to give a constant flow of water or for the purpose of spreading the water—a vessel something after the form of the washer now in use; but instead of the gas going into the box in bulk, causing a large pressure, if it were allowed to enter by a number of small apertures, so as to enable the pressure to be reduced to a minimum, not only would the ammonia be more efficiently removed, and a saving in cost of purification effected, but the quantity of gas liquor produced would be largely increased. I lately saw, at the Lanark Gas Works, an arrangement that fully effected this purpose.

The whole question of purification is now receiving considerable attention, and the possibility of removing the whole of the impurities in closed vessels is quite within the bounds of probability, and it is not necessary to point out to members of this Association how very worthy this important consideration is of their very closest study. The saving of purifying material, labor, and convenience, with the avoiding of the nuisance which, by the present system of purifying, is incidental to gas works, is a sufficient argument in favor of a change such as is looked for.

One very important point for consideration in endeavoring to improve the present system is to effect the purification of the gas so that impurities may be removed in a saleable form. All the impurities removed from the gas, with the exception of ammonia, are at present a waste in Scotch gas works; and when it is considered how valuable these impurities are to other manufacturers, it is evident that we have not yet arrived at the proper mode of turning to account. It behooves us therefore to use every effort in our power to discover some practicable means whereby this could be done.

In closing these remarks I would simply call the attention of the members present to the various articles exhibited, relating both to distribution and consumption of gas. The gentlemen exhibiting are present, and will, I am sure, be glad to give any information or explanation that may be wished. And, in case it may be overlooked, I must at this time ask you to express the cordial thanks of the meeting to those gentlemen for the trouble and expense they have put themselves to in assisting to make this meeting a success.

Resolutions of Respect for the Late Mr. Wm. B. King.

At a meeting of the West of Scotland Association of Gas Managers, held in his Lordship's Larder, St. Enoch's Square, Glasgow, on Tuesday, the 22d Oct., it was moved by the President (Mr. S. Stewart, of Greenock), and seconded by Mr. M'Gilchrist, of Dumbarton, "That an extract from the minutes of this meeting be sent to Mr. King, expressing their great regret to learn of the death of his father, Mr. Wm. B. King, Editor and Publisher of the *Journal of Gas-Lighting*, and their sincere sympathy with his family for the great loss they had sustained—a loss that was felt by the whole body of Gas Managers."

At the meeting of the Midland Association of Gas Managers, held in Birmingham last Thursday, a resolution was unanimously adopted, "expressive of profound regret at the death of one to whom gas lighting owes so much as to the late Mr. Wm. B. King, whose loss is felt by many as that of a personal friend; and tendering to his family heartfelt sympathy for them in their bereavement."—*Journal of Gas-Lighting.*

Washing Glass.

Such a subject may seem *too* simple, but yet the more I see students at their work the more I am impressed with the fact that but few know how to wash a beaker-glass *clean*.

Some time since I took breakers from various students in my laboratory (which they had washed and put away), and held them under a powerful stream of water until they were thoroughly wet. On taking them from under the spout, in almost every case the water ran off the glass in spots, showing that the glass was greasy.

The best thing to wash beakers, etc., with, according to my experience, is sand-soap. Naturally, the sand must not be sharp. The soaps containing infusorial earth are most excellent for this purpose. Borax soap is also very efficacious. A piece of board about 20 c.m. long, 15 c.m. wide, and 4 c.m. thick, should be screwed on to the right (inside) of the sink. In this block a rectangular hole, about 2 c.m. deep, and 1 c.m. smaller than the section of the soap when stood on its long end, is to be cut. The bottom of the cake of soap is then whittled away so that it fits tightly in the hole. It is now moistened and pushed into the aperture, where it remains tightly fixed. By wetting the right hand thoroughly and rubbing on this soap ridge a good lather is made. With the soapy hand the glass is rubbed and washed until, on taking it from under the stream, no oily spots appear, the glass appearing wet all over. The beaker is then dried with a good towel ("glass towel"), and finally polished with a piece of chamois or kid leather. The final polish with kid is necessary, since the best towel leaves fibres on the glass. In cleaning test-tubes it is only necessary to rub the probang on the soap.—*Chem. News.*

THE AMERICAN GAS LIGHT JOURNAL AND CHEMICAL REPERTORY

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PROPRIETORS.

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THURSDAY, JANUARY 2, 1879.

Official Report of Examinations of Gas for three Weeks ending Nov. 28, 1878, made at the Photometrical Room of the Department of Public Works.

Corrected Illuminating Power.

Dec. 1788.	Time of Day at which Test were made.	New York Gas Light Co.	Manhattan Gas-Light Co.	Mutual Gas-Light Co.	Metropolitan Gas-Light Co.	Harlem Gas-Light Co.	Municipal Gas-Light Co.
9		16.38	17.20	18.77	17.69	16.62	
10	Between	16.44	17.04	18.52	17.40	16.56	
11	9.30 A.M.	16.00	16.62	18.56	17.29	16.08	
12	and	16.04	16.26	18.52	17.13	16.34	
13	1 P. M.	15.57	16.22	18.76	17.67	16.77	
14		16.77	17.44	19.07	17.40	16.43	
	Average	16.20	16.79	18.70	17.43	16.46	
16		16.66	16.47	19.23	17.08	16.11	
17		16.40	16.53	19.55	17.00	16.00	
18		——	17.11	19.57	17.07	15.00	
19		16.12	17.22	18.79	16.55	15.68	
20		16.51	17.14	19.83	17.02	15.47	
21		16.82	16.97	——	16.80	15.72	
	Average	16.50	16.90	19.39	16.92	15.66	
23		16.52	17.38	19.08	16.96	15.66	
24		15.73	16.15	19.33	16.63	16.61	
26		14.95	16.34	19.77	16.88	16.60	
27		15.28	16.65	19.21	17.19	16.51	
28		14.56	15.68	17.34	17.08	16.58	
	Average	15.41	16.44	18.94	16.95	16.39	

Sugg-Letheby burner.

E. G. LOVE, Gas Examiner.

Correspondence

[We are not responsible for the opinions expressed by Correspondents. Correspondents, in all cases, should sign their communications with their names and address in full—not for publiction, unless desired, but as a guarantee of good faith.—ED.]

Comparative Economy of Electric and Gas Light.

In the London *Engineering* of Oct. 11 there is a communication relating to this question, where the results of the most recent developments of the electric light, in comparison with gas light, are fully presented.

A summary of the paper, which is necessarily of much length, exhibits that for absolute economy in the force expended, taken on the basis of the convertibility of heat into mechanical effect, the electric light is at least one hundred times more efficient than the gas light. And this estimate is based on the light produced per horse power expended, as found by some experiments made at the Franklin Institute, in Philadelphia, while all the European makers of dynamo-electric machines claim nearly five times the quantity of light per horse power.

Again, if the cost of producing the coal gas—that is, the heat which would proceed from the coal needed to make the coal gas—be taken in place of what the coal gas itself would evolve when burned, the above ratios are made over twice (2 3) more unfavorable for the efficiency of coal gas.

From all of which it is evident that the possibility of electric lighting, as compared with the reality of gas lighting, is enormously in favor of the former.

But as the source of electricity is found in the dynamo electric machine, which derives its motion from a steam engine; and as the steam engine is, even in its most approved form, probably the most wasteful utilization of natural force; the expenditure of heat, as derivable from the coal to be burned under the boiler of a steam engine (of such size as is suitable for driving dynamo-electric machines) when compared to that derivable from the coal demanded to make coal gas, is 2 2 times less for electric than for gas light, if the Franklin Institute values for electric light be taken, and 11 times less if Siemens' or Gramme's results for their machines be adopted.

According to the Franklin Institute experiments, to produce a given quantity of light by the two systems, there must, for electric light, for each pound of coal burned under the boiler of a steam engine, be $5\frac{1}{4}$ pounds of gas coal distilled in a retort; and the question is, whether the apparatus in either case is more or less expensive originally, or in repairs; and whether the operating of the same will demand greater or less skill or time of workmen?

It is stated that the result of 380 candles per horse power, representing the power demanded to produce the light of the best spermaceti candle by the electric system, is that of 90 pounds weight falling one foot per minute. A man ascending a flight of stairs at a very moderate rate will have expended a force equal to three candles. The results claimed by the makers of electric machines are five times as good as this.

The electric light, wherever it is desirable to illuminate from one point, either at considerable distance or by great volume of light, therefore is greatly more economical than gas light at the present time, with a promise of yet higher relative efficiency. And the adaptability of the electric system to smaller, or even domestic uses, would seem to be only a question of time for research and ingenuity to mature.

The enormous advantages of the electric light as regards comfort, health, and safety, when compared with illumination by combustion of any substance whatever, are obvious, and the attainment of much less success than has been already reached would warrant the substitution of the new light for the old.

The complete absence from flickering so objectionable in all gas light, being only partly relieved by the argand burner (an objection which causes many to resort to the student's lamp, using petroleum as a substitute for gas light, when reading or sewing), constitutes a great superiority for the electric light. The blinking of some of the exhibited electric lights is a fault of the apparatus not incident to the system at all

An observation of particular electric lights for a long time showed that the light from a good apparatus did not vary to the eye oftener than once in a quarter hour at the most frequent, to even longer times at the less frequent disturbances. While the effect of the instantaneous cessation or aberation on a reader was less than that of a summer cloud, which should obscure the sun for the same length of time only. In fact readers cannot but rarely discern the diminution of light. Of course a perfect light for illuminating purposes would never vary, and the perfectability of the electric system, and of any other, will, and in the nature of things must, be *relative*.

ROBERT BRIGGS.

[While we have the very highest possible respect for the opinions of the author of the above, still, somehow or other, as far as we have been able to learn, the practical facts do not sustain the theories above set forth as to "possibilities of electric light, as compared with the reality of gas-lighting." We have just received a paper upon the relative cost of gas and electric light, as used in mills at Waltham, Mass.

Owing to the lateness of the time of receiving the paper, its publication is unavoidably delayed until our next issue; but we summarize some of the results as showing what the practical cost of electric light is, in this case, as compared with the cost of the gas displaced by it.

The room lighted is ninety by one hundred and fifty ft. The actual cost of *gas* is given at $344 per annum. Two machines supply ten electric lamps, which now light the room, with the aid of 20 gas burners. The cost of electric light is given as follows:

10% on cost of machinery.....	$300 00
20 horse-power, one year.....	166 60
Carbons consumed "	100 00
20 gas burners still in use.....	50 00
Total.....	$616 60

In the above no charge is made for attendance, and the result is $272.60 in favor of gas.—ED.]

Gas or Naphtha?

"One gas lamp is worth more than two 'policemans,'" said Ald. Jacob at a session of the council last spring, and the crowd laughed, as did also his fellow-aldermen. To-day Jacob can laugh, as the great majority of people have come to the same conclusion. Crime lurks in dark places, and a thief shuns the light as he would a "blue coat," only a little more so.

Last spring, by reason of the gas companies' extortionate and unreasonable charges, the taxpayers almost unanimously demanded a reduction or a change. The gas men were obstinate, and the new-fangled naphtha stepped in and, at a very low price, carried off the city contract. The public was satisfied, monopolists disgusted, and everything seemed O K. Very soon, however, the disadvantages of the naphtha system became apparent. The light was poor; reflection insignificant; a strong gust of wind, as fall approached, extinguished hundreds of burners, and Detroit has finally established a reputation as the worst lighted city of its extent and population in the world. The naphtha company also find they have not so big a bonanza as they imagined. In a word, they figured so low on their contract for lighting the streets that it doesn't pay.

To get at the gist of all this Controller Bridge and

other city officials have been figuring up, and no one more than they will sustain Jacob's old-time ideas as to the value of light and plenty of it. The naphtha company's contract expires January 31st next, so that shortly after New Year's the proper steps will be taken to secure bids for light for 1879. As the naphtha men are losing money under this present contract, they certainly will demand higher rates for another year, and this will at once place them in close competition with the gas companies, who, if they have any sense, will come down to hard-pan at once and satisfy the people that they have at least some regard for the municipality which protects and supports them.

In Cleveland, as a comparison, the rate paid by the city for gas consumed by street lamps is $1 50 per thousand. Cleveland burns upwards of 1,200 more lamps than Detroit, besides having the advantage of cheaper coal by reason of location. Allowing for all this, however, it is thought that the Detroit corporations could furnish the city gas for at least $1 75, and still have a good margin for profit.

Relative to the subject of more light, as soon as the incoming council gets itself comfortably seated, an earnest effort will be made to increase the number of gas lights by 1,000, and of plain naphtha lamps by 500, thus adding 1,500 burners to the present capacity. A majority of the city officers and the new council will undoubtedly favor the proposition as one which will tend greatly to enhance the safety and convenience of all classes of citizens, to say nohting of property.

In this connection it may be stated that the gas inspector has frequently been blamed for the remarkable performances of the naphtha blazes throughout the city. That official is in no way responsible for "naphthaisms," as the existing contract relieves him from the duty, heretofore imposed on his predecessors, of attending to the quality of the lights furnished by the contractors.—*Detroit News.*

Reduction in the Price of Gas in Houston, Texas.

By advertisement in another column it will be seen that, on and after the 1st of January next, the price of gas will be reduced to $4 per thousand feet to all consumers of less than 5,000 feet per month, and to those who consume over that a further reduction of ten per cent.

This voluntary action of the gas company, without any extraordinary outside pressure, exhibits a landable desire on their part to meet the necessities of the people as far as possible. The company have erected works costing a large sum of money, and have kept up, at considerable additional outlay, with all the improvements in gas machinery, until now we doubt whether any city in the union is supplied with a better quality than is Houston. The hard times have laid a heavy hand upon our citizens generally, but upon none has the depression borne more heavily than upon the gas company. The necessity for close economy caused many of the consumers to resort to the use of illuminating oils, and the pecuniary troubles of the city shut off the gas from the streets. Notwithstanding, the company have maintained their works in first-class order, and furnish the best gas now in use in Texas. Aided by returning prosperity, and encouraged by the reduction in price, many old consumers will doubtless return to the use of gas. Its vast superiority over oil as an illuminator, its cleanliness, convenience, and safety, are powerful inducements to its use. It requires no filling of lamps, no trimming of wicks, involves no breaking of chimneys or lamps, and never causes any conflagrations, as many of the oils in common use frequently do. Every housekeeper who has ever used it is well aware of these facts, and the question of price is the only objection. The reduction now made by the company brings the price here to very near that of other cities, when our remoteness from the coal fields and the expense of transportation of the coal is considered; and it may justly be regarded as very reasonable, in proportion to the amount consumed.

We would be glad to see the liberal spirit evinced by the company met by a corresponding increase of patronage; and we sincerely hope the incoming city administration will be able to provide for the relighting of the streets. We feel assured the matter can be arranged, our present darkened streets be once more relighted, and no longer suffered to be fit only for footpads and thieves to ply their avocations. Give us light.—*Daily Telegram, Houston, Texas.*

Mending Platinum Crucibles, Etc.

By Thos. Garcide, F.C.S.

Some months ago I had a platinum dish, which had a small hole on the side near the bottom, and the dish was consequently useless for most purposes. I was about to consign it to the old platinum, when it struck me, this metal being "weldable," I might manage to repair it. Having already a mould for this dish, made of plaster of Paris, and not of wood, this served admirably as an anvil. I then cut a piece of moderately thin platinum foil, about 3 m.m. diameter, and rubbed this and the part of the dish where the hole was with sea-sand until perfectly bright and clean. Having fixed the dish and its mould in an up right position, I laid the platinum foil over the hole and directed the flame from a table blowpipe upon the spot. A pair of scissors served as a hammer, and by gently tapping with these the two pieces of platinum united perfectly, and made so neat a joint that one would scarcely observe it unless one's attention was called to it. I have used the dish for all kinds of purposes since, but the union is as good as ever. In the above operation the plaster of Paris mould, although very dry, was split and cracked by the heat in all directions, nevertheless it had sufficient cohesion to last until the operation was concluded. I find that platinum wires are very easily joined in this way.—*Chemical News.*

Exhibition of Gas Apparatus at Bridgnorth.—Following in the wake of other towns, the Bridgnorth Gas Company, at the suggestion of their Manager (Mr. J. Gill), last week held an exhibition of gas apparatus, entirely devoted to the use of gas apart from lighting. Messrs. John Wright & Co., of Birmingham, and Messrs. Billings & Co, of London, were the principal exhibitors, and both displays were highly creditable. On Tuesday and Wednesday evenings Mr. H. Gore, of London, delivered his two popular lectures. A very good audience assembled to hear the first, and on Wednesday the hall was crowded to excess, all the standing room being occupied—a clear evidence of the interest excited. The result of the exhibition has been very satisfactory to the company; the sales of stoves and apparatus in the room amounting to upwards of £150, which means a very important increase in the consumption of gas at Bridgnorth. Each effort made by companies to enlighten the public on the value of gas for heating and cooking purposes will materially enhance the value of their property, and the large attendance which Mr. Gore secures to his lectures proves that the public are anxious to procure reliable information, and will listen quite as readily to a truthful exposition of the advantages of gas as they formerly did to the ridiculous tirades of cheap-gas agitators. Among the exhibits at Bridgnorth, one of Otto & Co.'s silent gas-engines was at work; this was sold in a few hours after the exhibition opened, and several more are inquired after. Mr. Gill deserves special praise for the care and attention he displayed in carrying out the arrangements of the exhibition.—*London Journal of Gas-Lighting.*

The Litigation Proceedings between the Liverpool Gas Company and the Mersey Dock Board respecting the destruction by fire of a landing stage in 1874 have been concluded, the gas company agreeing to pay £17,500 in addition to the £70,000 already paid.

Gas Stocks.

Quotations by G. W. Close Jr., Broker and Dealer in Gas Stocks.
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24 Pine street, New York City.

January 2, 1879.

☞ All communciations will receive particular attention
☞ The following quotations are based on the par value of $100 per share. ☜

	Capital.	*Par.*	*Bid.*	*Asked.*
Gas Co.'s of N. Y. City.				
Central	466,000	50	—	75
Harlem	1,800,000	50	25	30
" Bonds	170,000			103
Manhattan	4,000,000	50	145	150
Metropolitan	2,500,000	100	95	100
" Scrip	$1,000,000	...	85	92
Mutual	5,000,000	100	50	55
" Bonds, gold	900,000	1000	85	90
Municipal	1,500,000	100	75	80
" Bonds	750,000		95	95
New York	4,000,000	100	75	80
Nothern	270,000	50	—	100
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	115	120
Citizens	1,200,000	20	50	60
" Scrip	320,000	1000	90	95
Peoples	1,000,000	10	20	30
" Bonds	325,000	...	--	95
" Scrip	300,000	...	75	80
Metropolitan	1,000,000	100	50	60
Nassau	1,000,000	25	50	56
" Ctfs.	700,000	1000	—	90
Williamsburgh	1,000,000	50	65	75
" Scrip		...	88	92
Kings Co	200,000	100	80	90
Union Co. E. N. Y.		25	—	50
Richmond Co., S. I.	300,000	...	60	85
Out of Town Gas Companies.				
Bath, Maine	70,000	100		
Buffalo Mutual, N.Y	750,000	100	65	70
" Bonds	200,000	1000	95	100
Baltimore, Md	2,000,000	100	95	98
" Ctfs., gold	1,000,000		95	10
Bayonne, N. J		100		90
Brockport, N. Y	25,000	100	...	80
Citizens, Newark	918,000	50	87	91
" " Bds.	124,000	—	105	10
Chicago Gas Co., Ills			128	13
Cincinnati G. & C. Co.				190
Derby of Conn	160,000	100	60	80
East Boston, Mass		25	114	120
Elizabethtown, N. J.	300,000	20	—	130
Fort Wayne, Ind		100	...	—
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	140	148
Hempstead, L. I	25,000	100	...	—
Jersey City	386,000	20	120	130
Jamaica, L. I	25,000	100	...	—
Jacksonville, Ill	120,000	50	82	...
Lewistown Maine	400,000	100	70	80
Lima, Ohio	60,000	100	—	...
Bonds	30,000		90	
Laclede St Louis Mo.	1,200,000	100	—	75
Long Branch		20	30	40
New Haven, Conn		25	136	152
Peoples, Jersey City		...	—	80
" " Bds.				95
Peoples of Albany	650,000	100	10	17
" Bonds	350,000	1000	—	-
Peoples of Baltimore		25	44	48
" Bonds			106	—
Plainfield, N. J	80,000	100	—	105
Perth Amboy		25	—	95
Rochester, N. Y		100	50	60
Woonsocket, R. I	150,000	100	95	...
Halifax N. S	400,000	40	148	150
Hamilton, Ontario	150,000	40	117½	
San Francisco Gas-Co., S. Fr'isco Cal.			95	95¼
Pittsfield, Mass			120	130
Rondout & Kingston			75	80

The Mutual Gas-Light Company, of New York, habe declared their quarterly dividend of 1½ per ct., payable Jan. 10, 1879. The Jersey City Gas-Light Company have declared their semi-annual dividend of 7½ per cent., payable Jan. 1, 1879.

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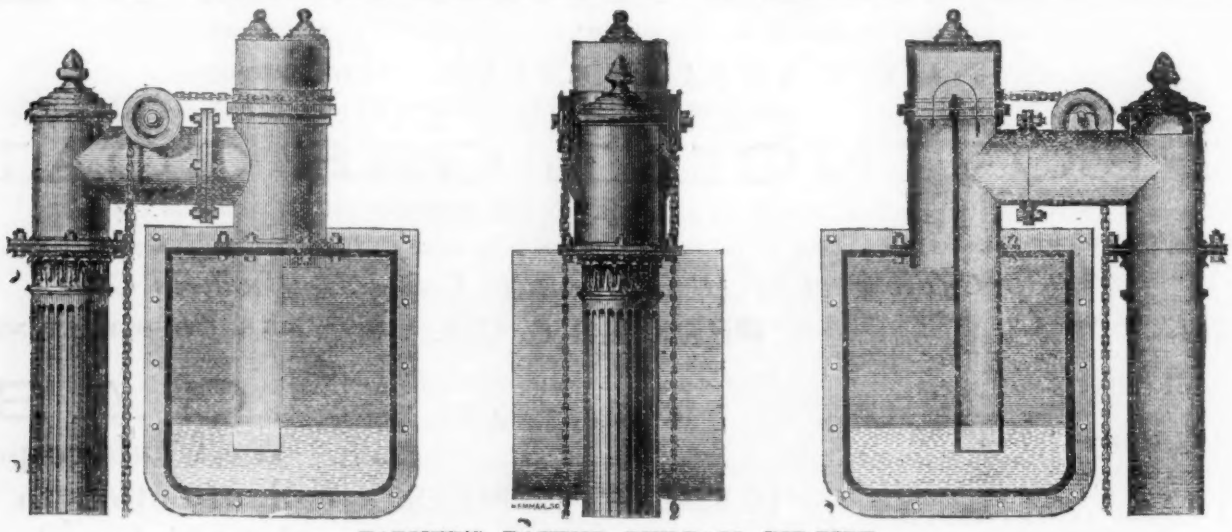

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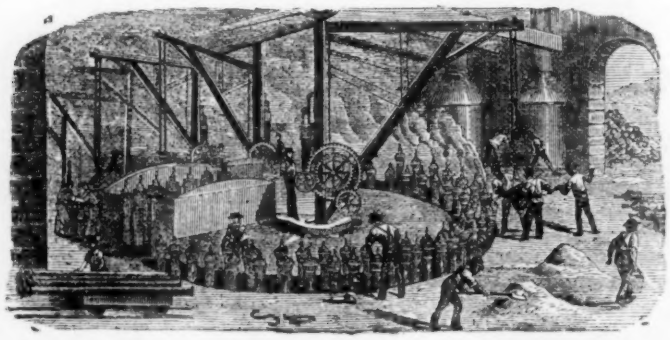

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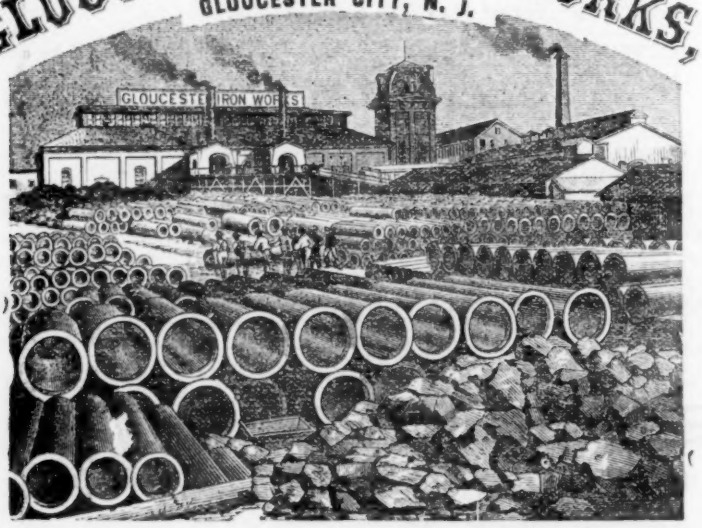

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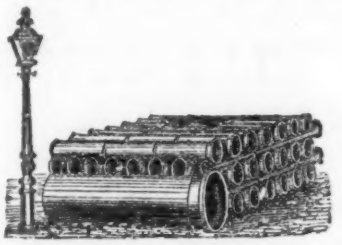

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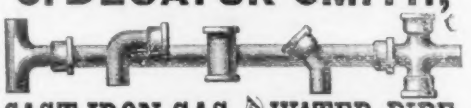

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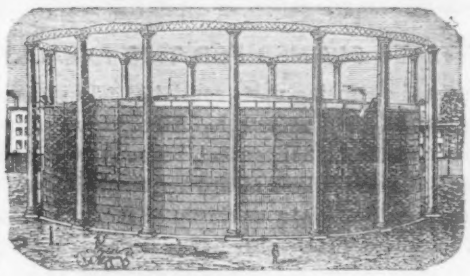

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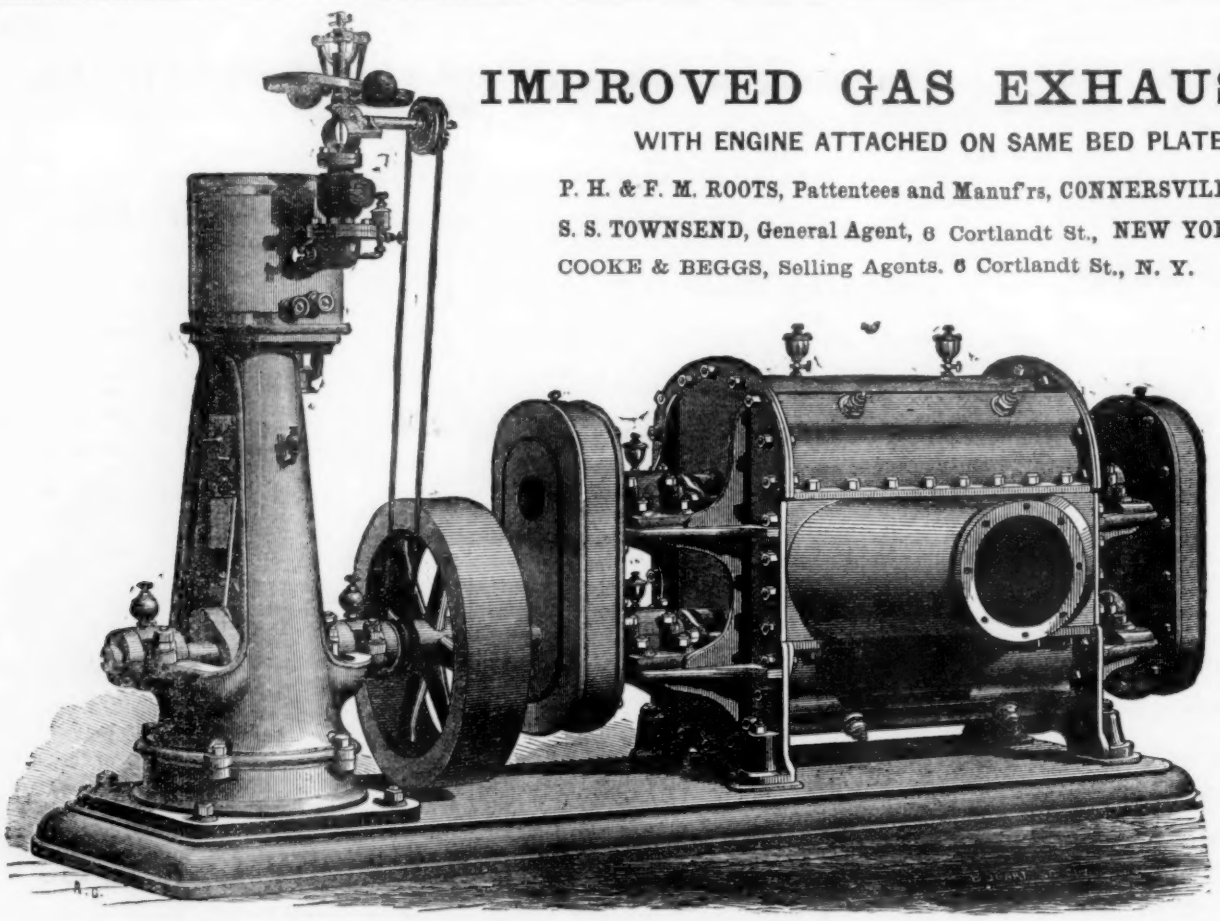

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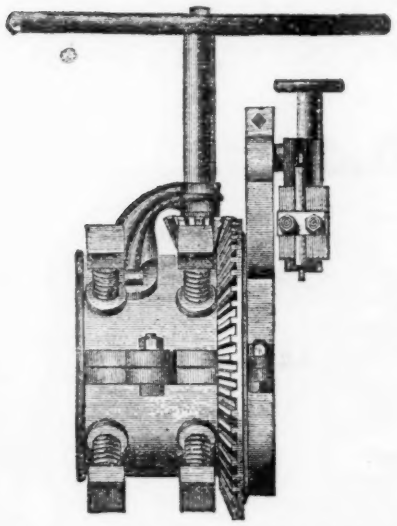

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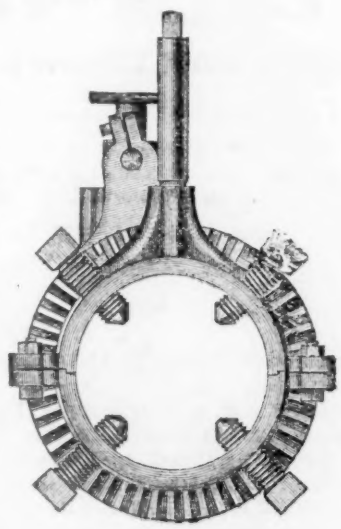

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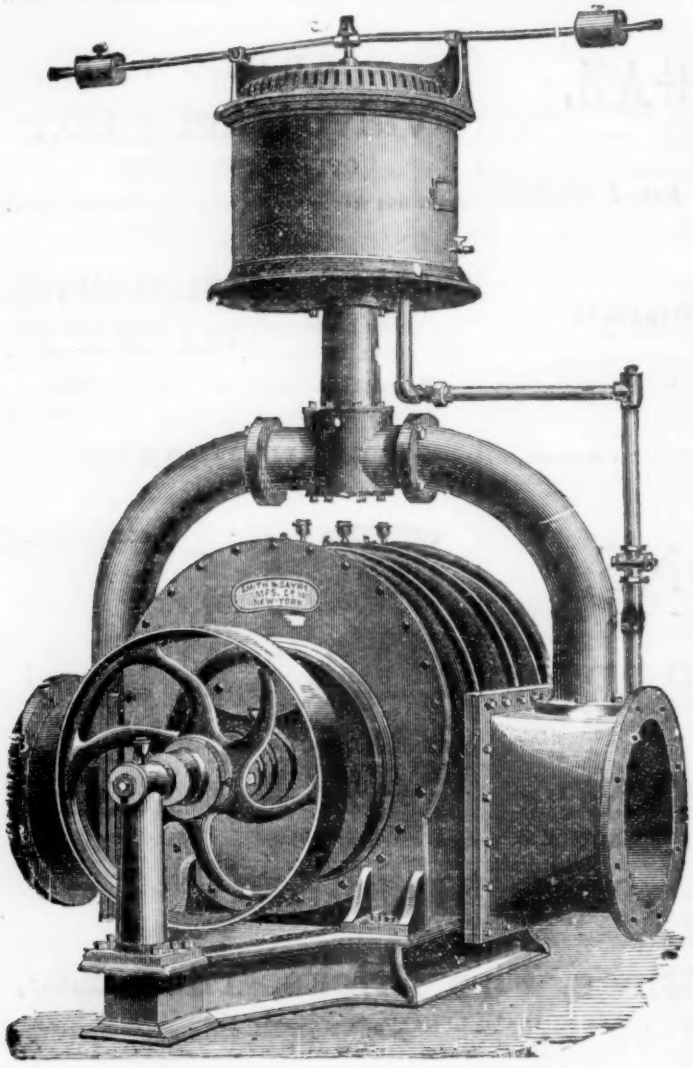

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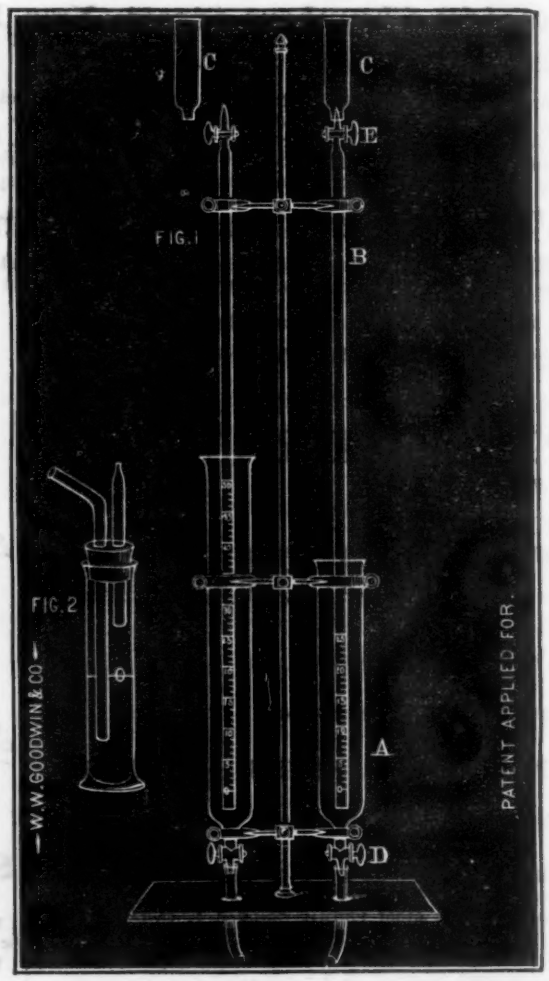

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